U.S. Army Center for Health Promotion and Preventive Medicine

USCHPPM

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M18 RED-COLORED SMOKE GRENADE

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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

- ★ *Integrity is the foundation*
- ★ *Excellence is the standard*
- ★ *Customer satisfaction is the focus*
- ★ *Its people are the most valued resource*
- ★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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14. ABSTRACT
This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M18 Red-Colored Smoke Grenades. This document present the evaluation of the potential for adverse human health effects to the offsite residents breathing air emissions following the use of military firing ranges during training exercises. Study results showed no protential for health risks to the hypothetical resident from inhalation of air emissions from the smoke grenades. To conduct this study, air emissions from the smoke grenades were collected in a test chamber (West Desert Test Center, Dugway Proving Ground, UT). This information was then used in an air dispersion model to determine ambient air concentrations at a location downwind from the site where the item was activated. Modeled air concentrations were combined with exposure information to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, to determine if there is a potential for health risks from inhjalation of these substances. The health risk included both long-term and short term exposures to the modeled substance concentrations. Study results showed no potential for helath risks from inhalation of air emissions from the M18 Red-Colored Smoke Grenade

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REPLY TO
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PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M18 RED-COLORED SMOKE GRENADE

EXECUTIVE SUMMARY

This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M18 Red-Colored Smoke Grenade (red-colored M18) during training exercises. The military uses pyrotechnics for signaling, obscuring, and illuminating during training and combat. Pyrotechnics are also used during training exercises to simulate battle conditions. Study results showed that no adverse health effects are expected, to the hypothetical resident, from inhalation of the air emissions from the red-colored M18.

To conduct this study, air emissions from the red-colored M18 were collected in a test chamber (Bang Box) at Dugway Proving Ground, Utah. The data collected from the Bang Box study provided the amount and types of substances released from the red-colored M18. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (328 feet) downwind from a site where the red-colored M18 may be used. Since the training facility in this study is hypothetical, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of exposures per year) to estimate the amount of each substance the hypothetical resident breathes. This intake was combined with the substance's health information, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine if there is a potential for health risks from inhalation of these substances.

The health risk study included both long-term (30 years) and short-term (15-minute or 1-hour) exposures to modeled substance concentrations. Study results showed that no adverse health effects are expected to be experienced, by the hypothetical resident, from inhalation of air emissions from the red-colored M18.

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LIST OF ACRONYMS

AEC	U.S. Army Environmental Center
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
ATV	Acute Toxicity Value
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
HCl	Hydrogen Chloride
NAAQS	National Ambient Air Quality Standards
NAC/AEGL	National Advisory Committee for Acute Exposure Guideline Levels
NEW	Net Explosive Weight
OEL	Occupational Exposure Limit
PM_{10}	Particulate Matter under 10 micrometers in size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TSP	Total Suspended Particulates
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M18 RED-COLORED SMOKE GRENADE

1. PURPOSE

This document presents the evaluation of the potential for adverse human health effects to offsite residents breathing air emissions following use of the M18 red-colored smoke grenade (red-colored M18) during training exercises.

2. AUTHORITY

Memorandum, U.S. Army Environmental Center, 4 June 1999, Subject: Pyrotechnics Risk Assessment.

3. REFERENCES

See Appendix A.

4. BACKGROUND

a. PYROTECHNICS AND THEIR USE

The term pyrotechnic is derived from the Greek words "pyr" and "techne" meaning fire and art. The terms pyrotechnics and fireworks are often used interchangeably. Examples of pyrotechnics include distress flares and fireworks used for commercial (public displays) and consumer use (e.g., sparklers). Every year, during New Year's Eve and Independence Day, fireworks are used for public displays across the country. For example, during the Year 2000 Independence Day celebration in New York City, 60,000 shells were launched during a firework display that lasted for 30 minutes.

The military uses pyrotechnics for four purposes: 1) as a method of communication through the use of signals, 2) to produce smoke to reduce enemy effectiveness, 3) for illuminating the field, and 4) to simulate battle conditions during training exercises. Pyrotechnics play an important role in both military training and combat. It is important that our troops are adequately trained to use them properly.

b. WHAT IS THE RED-COLORED M18?

The M18 smoke grenade is a type of pyrotechnic device used by troops for ground-to-ground or ground-to-air signaling (Reference 1). The M18 may be filled with one of four different smoke colors. These different colored smoke

signals can be seen over great distances when used against a terrain background of contrasting colors.

The red-colored M18 is 5.75 inches long, 2.50 inches in diameter, and weighs 19 ounces (Reference 2). The body of the red-colored M18 consists of a thin cylinder of sheet metal that is filled with a red smoke mixture. This mixture is made up mostly of a red dye, potassium chlorate, and sodium bicarbonate (same as baking soda).

c. USE OF THE RED-COLORED M18

M18s are used during many Army training events. These events are held at nearly every Army training installation. At most locations, the training areas are at least 1000 meters (over half a mile) away from populated areas. In general, two red-colored M18s are used during a day of training, which typically occurs five times per year.

The M18 contains a delay-igniting fuze so that smoke is not released immediately after the grenade is activated. This allows the soldier to throw the grenade, usually to a distance of approximately 35 meters (115 feet), before smoke is produced. The M18 will emit a cloud of colored smoke for 50 to 90 seconds. This colored smoke can be used for different purposes. For example, it can be used to mark friendly force locations for other ground troops. It can also be used to mark a landing zone during operations such as medical evacuation (Reference 3).

d. ASSESSMENT SUMMARY

The approach for this study consisted of two main portions: air dispersion modeling and exposure assessment. These are briefly discussed in the paragraphs below. Sections 5-7 present a more explicit discussion of the methodology used for this study.

Emissions data generated from the studies in the Bang Box at Dugway Proving Ground, Utah (Reference 4), were used with an atmospheric dispersion model to estimate the average concentrations that may be experienced by an offsite resident. Since this study is designed to provide results that would be applicable to most Army training facilities, the training area used in this evaluation was a hypothetical one. In addition, air-modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. For the purpose of this study, air concentrations were averaged over 30 years for chronic exposures and 1-hour or 15 minutes for acute exposures. These concentrations were compared to chronic health-based screening levels

(HBSLs) established by the U.S. Environmental Protection Agency (EPA) or acute toxicity values (ATVs) established by selected agencies depending on the exposure duration (i.e., 30 years versus 1-hour or 15 minutes). If the chronic or acute averaged concentrations ($C_{chronic}$ and C_{acute}) were greater than these screening levels, further analysis would be warranted to determine the potential for health effects. It should be noted that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

5. METHODS AND DATA COLLECTION

a. EMISSION FACTORS

Emission factors used to derive the air modeling emission rates used in this study were generated from the pyrotechnics emissions studies conducted in the Bang Box at Dugway Proving Ground, Utah (Reference 4). The Bang Box studies identified and quantified air emissions from the firing of training munitions. The data provided by the Bang Box studies included the net explosive weight (NEW) of the item, the compounds sampled, and compound-specific emission factors. Emissions data from the Bang Box studies are included in the first four columns of the air dispersion modeling output data in Appendix B.

b. AIR MODEL

(1) BACKGROUND

Air dispersion models are available to mathematically simulate plume behavior to estimate downwind concentrations of compounds emitted from various sources. However, specific models are not available to determine the dispersion of emissions from munitions used during training. Estimating the magnitude and location of these concentrations depends on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Since a specific model is not available for modeling the use of munitions during training, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) evaluated numerous air models to determine which would be suitable for use with munitions used during training. The USACHPPM recommended using the Integrated PUFF (INPUFF) model to estimate the dispersion of emissions from sources such as pyrotechnics (Reference 5).

(2) MODEL DESCRIPTION

The INPUFF Model (Reference 6) was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a cloud type release over short periods of

time, and computations can be performed for a single point source for multiple receptors. The algorithms used to calculate concentrations assume a vertically uniformed wind direction (with no chemical reaction) to compute the contribution of each cloud at a receptor for each time step/interval.

(3) ASSUMPTIONS

Some assumptions were made to best represent the red-colored M18 in the air model. These assumptions were as follows:

(a) Initial cloud dimensions are preferred to model the air emissions from these types of releases. However, this information was not measured during the Bang Box studies; therefore, assumptions had to be made. Typically, with conventional point sources, the cloud rise and formation are determined by characterizing flue gas exit velocity, temperature, and stack diameter. However, for unconventional sources with no physical stack dimensions, such as the red-colored M18, the cloud temperature was set close to the ambient temperature, and a low exit velocity (0.1 meter per second) was used. Using a low exit velocity assumes essentially no cloud rise resulting in higher ground level concentrations to provide a more conservative estimate of air emissions. The source parameters used to model the red-colored M18 are included in Table 1.

TABLE 1: SOURCE PARAMETERS

Source/Stack Diameter	0.061 meters
Source/Stack Height	0.15 meters
Source Exit Temperature	298.15 degrees Kelvin (°K)(or 77 °F)
Exit Velocity	0.1 meters/second

(b) Since this study does not look at a specific training site, generic, worst-case meteorological data were used. To determine the worst-case meteorological conditions that would result in the highest air emission concentrations, an analysis was performed using the EPA Risk Management Program Guidance (Reference 7). This guidance includes tables for estimating the footprint of chemical releases and is intended to inform emergency responders of potential accidental releases. The EPA has defined most default conditions for meteorological modeling parameters. Table 2 lists the meteorological parameters that were used in the air model.

TABLE 2: WORST-CASE METEOROLOGICAL PARAMETERS

Wind Speed	1 meter/second
Atmospheric Stability	Category F
Wind Direction	270°
Ambient Temperature	293 degrees Kelvin (°K) (or 68 °F)

(c) For the purposes of this study, a hypothetical offsite resident was assumed to be located 100 meters directly downwind from the source. The meander of the cloud is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no cloud meander and therefore the cloud remains more concentrated. This assumption provides the most conservative modeled concentrations.

(4) GENERAL METHODOLOGY

(a) For the red-colored M18, the highest modeled concentrations were seen at the 100-meter location. This means that concentrations at distances greater than 100 meters were lower. This location was used in the exposure evaluation to provide the most conservative estimates of air emissions that offsite residents may be exposed.

(b) The model was run for a total calculation time of 900 seconds (15 minutes) to ensure that the total mass of the cloud had passed the receptor locations and to acquire 15-minute average concentrations for use in the exposure evaluation. Concentrations were calculated every two seconds. The model indicated that the initial cloud reached the hypothetical offsite resident within 80 seconds and dissipated below the lowest concentration the model calculated, which in this instance (1×10^{-10} g/m^3) occurred within 240 seconds. Table 3 contains the air model input parameters used in this study.

TABLE 3: AIR MODEL INPUT PARAMETERS

Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	900 seconds
Number of updates to the source (NSRCDS)	15
Duration/time step between each source update (ISUPDT)	60 seconds
Total time modeled/Simulation Period (NTIME) (ITIME)= (NSRCDS) (ISUPDT)	900 seconds

(5) USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model were based on a unit emission rate of 1 gram/second from an emission source and did not represent any pollutant-specific concentrations from the use of pyrotechnics. This unit emission rate is typically used for ease of modeling purposes. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of the predicted concentration to the unit emission rate was multiplied by each pollutant-specific emission rate to provide pollutant-specific concentrations.

(6) DETERMINATION OF POLLUTANT-SPECIFIC EMISSION RATES

(a) The actual pollutant emission rate per item (ER_1) for each pollutant was calculated using the following equation:

$$ER_1 = \frac{M \cdot CV}{t} \qquad \text{Equation 1}$$

where:

ER_1 = emission rate for one item (g/(item*sec))
M = total mass (lb) of pollutant emitted per item (lb/item)
CV = conversion factor (453.59 g/lb)
t = release duration in seconds as obtained from the training manual (References 2, 8)

Example 1
Sample Calculation Using Equation 1:

$$ER_1 = \frac{(1.510\,E-01)(453.59)}{(120)}$$

= 5.706E-01 g/(s*item)

Calculation provided for total suspended particulates (TSP). Averaged adjusted emission factor of TSP in lb/item was obtained from Appendix B.

(c) Pollutant-specific ambient concentrations for one item (CONC) were calculated using the following equation:

$$CONC = ER_{EV} \cdot \frac{UC}{ER_{unit}} \qquad \text{Equation 2}$$

where:

CONC = pollutant concentration based on one item (g/m^3)
ER_1 = emission rate for one item (g/s)
ER_{unit} = unit emission rate as used in the model (g/sec)
UC = concentration based on the unit emission rate (g/m^3)

Example 2
Sample Calculation Using Equation 2:

$$CONC = (5.706E-01)\frac{(3.510E-03)}{(1)}$$

$= 2.003E\text{-}03\ g/m^3$

Calculation provided for TSP.

c. EXPOSURE ASSESSMENT

(1) EXPOSURE ASSUMPTIONS

(a) Exposure assumptions were selected using a typical use scenario for the red-colored M18. This use scenario was provided by the U.S. Army Environmental Center (AEC), and is based on consultation with their senior training advisor (References 9, 10). This information is included below in Table 4 and is used for the chronic and acute exposure evaluations.

TABLE 4: FREQUENCY OF USE FOR THE RED-COLORED M18

Parameter	Value Used
Number of items used per training scenario	2 over a 24-hour period
Number of items used per training event	NA
Number of events per scenario	NA
Time between events	NA
Number of scenarios per year	5

NA = not available

(b) The frequency of use for the red-colored M18 was required to determine how much substance an offsite resident would be exposed to in the time period of interest (i.e., acute or chronic exposure). For the purposes of this study, a training scenario is defined as a day or session of training whereas a training event is defined as a single use of pyrotechnics. A training scenario may consist of multiple training events.

(2) TIME-AVERAGING

(a) For the chronic assessment, time-averaged concentrations were calculated using the EPA's default residential exposure duration of 30 years (this value assumes that the resident spends 30 years at the same residence). This was done to derive concentrations that would be consistent with the exposure duration used by the EPA so that estimated substance concentrations could be compared to their respective health-based screening levels.

(b) In this evaluation, training scenarios were assumed to occur five times a year (References 9, 10). Using the default residence time established by the EPA, the assumption was made that someone could be exposed to five training scenarios per year for 30 years. Table 5 lists the exposure parameters used to estimate concentrations for the chronic assessment. These parameters are based on the typical use scenario provided by AEC (Table 4) and the assumptions used in the air model run.

TABLE 5: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS

Exposure Parameter	Value Used
Exposure Time (ET)	15 minutes/item[1]
Exposure Frequency (EF_{day})	2 items/day[2]
Exposure Frequency (EF_{year})	5 days/year[2]
Exposure Duration (ED)	30 years[3]

[1]Based on the total model time of 900 seconds (15 minutes) used in the air model run.
[2]From Table 4.
[3]EPA default value.

(c)The daily averaged concentrations were calculated using Equation 3. To continue with the examples used previously (Examples 1 and 2), TSP is used to illustrate how this equation is applied. It should be noted that the

average modeled concentration was converted from g/m^3 to µg/m^3 before it was used in Equation 3.

$$C_d = \frac{CONC \cdot ET \cdot EF_{day}}{1440} \qquad \text{Equation 3}$$

where:

C_d = average daily concentration (µg/m^3)
$CONC$ = average modeled concentration for one item (µg/m^3)
ET = exposure time (minutes/item)
EF_{day} = exposure frequency (items/day)
1440 = unit conversion from minutes to day

Example 3
Sample Calculation Using Equation 3:

$$C_{d(TSP)} = \frac{(2.003E+03)(15)(2)}{1440}$$

= 4.173E+01 µg/m^3

The averaged modeled concentration (CONC) for TSP was obtained from Appendix B. The exposure parameters were obtained from Table 5.

(d) Chronic averaged concentrations were calculated using Equation 4. The resulting concentration (C_d) from Equation 3 was used in Equation 4 to determine the averaged chronic concentrations. Example 4 shows how this calculation was performed.

$$C_{chronic} = \frac{C_d \cdot EF_{year} \cdot ED}{AT} \qquad \text{Equation 4}$$

where:

$C_{chronic}$ = average chronic concentration (µg/m^3)
C_d = average daily concentration (µg/m^3)
EF_{year} = exposure frequency (days/year)
ED = exposure duration (years)

AT = averaging time (days)
(for carcinogenic endpoint, AT = 70 years x 365 days;
noncarcinogenic endpoint, AT = ED x 365 days)

Example 4
Sample Calculation Using Equation 4:

$$C_{chronic(TSP)} = \frac{(4.173E+02)(5)(30)}{(30)(365)}$$

= 5.72E-01 µg/m^3

The average daily concentration was calculated as shown in Example 3. The exposure parameters were obtained from Table 5.

(e) Unlike the chronic evaluation, guidance for evaluating acute exposures is not currently available. Due to the nature of the use of pyrotechnics, acute exposures cannot be overlooked. For the purpose of this study, acute exposure is defined as a 1-hour or 15-minute exposure. The 1-hour or 15-minute acute exposure averaging times allow for comparison with guidelines developed specifically for emergency planning purposes (see discussion on acute toxicity below).

(f) The exposure frequency is based on the number of events per 1-hour or 15 minutes depending on the guideline used for comparison. This information is based on the use scenario provided by AEC (Table 4). To determine the maximum number of items that may be used in 1-hour, it was conservatively assumed that two red-colored M18s might be activated all at once during an event. The average acute concentrations were computed using Equation 5. Example 5 contains a sample calculation of this equation. Since TSP does not have an acute toxicity value, hydrogen chloride (HCl) is used as the example compound.

$$C_{acute} = \frac{CONC \cdot ET \cdot EF_{hour}}{60} \qquad \text{Equation 5}$$

where:

C_{acute} = average acute concentration (µg/m^3)
CONC = average modeled concentration for one item (µg/m^3)
ET = exposure time (minutes/item)
EF_{hour} = exposure frequency (items/hour)

60 = unit conversion, 60 minutes/hour

Example 5
Sample Calculation Using Equation 5:

$$C_{acute(HCl)} = \frac{(3.64E-02)(2)(15)(1/0.25)}{60}$$

$$= 7.28E\text{-}2\ \mu g/m^3$$

The average modeled concentration (CONC) for HCl was obtained from Appendix B. Since the acute toxicity value for HCl is based on a 15-minute exposure duration (TEEL), the acute concentration was averaged over 15 minutes (0.25 hours) so that C_{acute} can be compared with its toxicity value.

d. TOXICITY ASSESSMENT

The potential for adverse health effects was determined by comparing time-averaged air concentrations to health-based screening levels, which are developed from a substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of screening values used for the chronic and acute evaluations.

(1) CHRONIC ASSESSMENT

(a) The chronic assessment was evaluated using a screening approach. Using this method, a substance's estimated time-averaged air concentration was compared to its HBSL. If this ratio was less than one, no further analysis was required. This approach is conservative because the exposure assumptions used by the EPA, to establish HBSLs, assume that the resident is exposed for 350 days per year (assuming 2 weeks vacation per year). Since the training scenarios, in which the red-colored M18 is used, are not expected to exceed five days per year, HBSLs specific to this study (if they were developed) would likely be higher.

(b) The HBSLs were obtained from the EPA, primarily from Region 3 and Region 9 (References 11, 12). To ensure that the most recent information was used, the Internet sites of both regions were checked. Although the general approach used by both Region 3 and Region 9 is the same, the exposure assumptions differ enough so that final recommended screening levels can vary to a certain degree. In both methods a substance's HBSL is selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has a known systemic toxicity and is a carcinogen, concentrations were calculated using both toxicity values. To maintain a

conservative approach, the lower concentration was selected as the recommended screening level.

(c) A hierarchy was developed in order to quantitatively evaluate for as many of the identified substances as possible. Since the methodology used by Region 9 results in lower HBSLs than Region 3, the Region 9 preliminary remediation goals (PRGs) were used first. Region 3's risk-based concentrations (RBCs) were only used when a PRG was not available. The only exception was for chromium (VI) [Cr (VI)] where Region 9 used a carcinogenic toxicity value that was seven times greater than the EPA's recommended value to develop its screening level for inhalation exposure (Reference 13). Since the EPA does not advocate the application of this multiplication factor, the RBC for Cr (VI) was used instead of the PRG.

(d) Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to establish National Ambient Air Quality Standards (NAAQS) (Reference 14) for several substances considered harmful to public health and the environment. Currently, NAAQS are available for six substances, of which carbon monoxide, nitrogen dioxide, lead, sulfur dioxide, and particulate matter < 10 micrometers (PM_{10}) have been detected in the red-colored M18 Bang Box study. The NAAQS for the longer averaging time were used for the chronic evaluation. Depending on the substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured TSP were PM_{10} (Reference 4), the NAAQS for PM_{10} was used to evaluate the potential for health effects from exposure to TSP. Example 6 shows a sample calculation of how a substance's estimated chronic concentration is compared to its HBSL.

Example 6
Sample Calculation Comparing a Substance's Estimated Chronic Concentration to Its HBSL:

$$\frac{C_{chronic(TSP)}}{HBSL} = \frac{5.72E-01}{50}$$

$$= 1.14E\text{-}02 < 1$$

In this case, the resulting ratio is two orders of magnitude less than one, indicating further evaluation is not necessary.

(e) Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) (Reference 15)

was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, it was recommended that mixtures be separated according to a substance's number of carbons and its chemical class (i.e., aliphatic or aromatic[1]). Generally, as a substance's carbon number increases, its molecular weight increases and it is therefore, not a substance of concern via inhalation. The working group also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 15).

(f) Table 6 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this study, the reference concentrations (RfCs) were converted to PRGs using Region 9 assumptions. The resulting PRGs are included in Table D-4 in Appendix D.

TABLE 6: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS[1]

Carbon Range	Aromatic Inhalation RfC (mg/m^3)	Aliphatic Inhalation RfC (mg/m^3)
$C_5 - C_6$ $C_{>6} - C_8$		18.4
$C_{>7} - C_8$	0.4	
$C_{>8} - C_{10}$ $C_{>10} - C_{12}$ $C_{>12} - C_{16}$	0.2	1.0
$C_{>16} - C_{21}$ $C_{>21} - C_{35}$	NA	NA

[1]Reference 15
NA = not applicable for high molecular weight TPHs ($C_{>16}$) because compounds in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.

(2) ACUTE ASSESSMENT

(a) As previously indicated, an acceptable method for assessing acute health effects is not currently available. It was not until recently that EPA guidance addressed the need to evaluate acute health effects from inhalation (Reference 17). Even then, acute toxicity data for risk assessment purposes were not readily available. The EPA recognized this deficiency and spearheaded the National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances (NAC/AEGL Committee). Currently,

[1] Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene) (Reference 16).

AEGLs are available for only a handful of substances, of which only three are found in the list of compounds from the red-colored M18 emissions data.

(b) To circumvent this problem, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although suggestions have been made to use occupational exposure limits (OELs) by applying additional safety factors (References 18, 19), OELs were not used in this study because they introduce even more uncertainty than the use of emergency guidelines. The OELs are designed to protect the workplace environment and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute.

(c) In comparison, emergency planning guidelines are more appropriate because they are typically developed for exposures of 1-hour or less. In addition, safety factors may also have been included depending on the agency that develops these guidelines, so that the values would be protective of the general population.

(d) Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA) (Reference 20) and the Temporary Emergency Exposure Limits (TEELs) developed by the U.S. Department of Energy (DOE) (Reference 21) were used for this study, specifically the ERPG-1s and the TEEL-1s (with the exception of the three AEGLs that were available). Since TEEL-1s are intended for 15-minute exposures, air concentrations compared to TEELs were averaged over a 15-minute period. Air concentrations compared to ERPGs and AEGLs were averaged over 1-hour, as these values were developed for 1-hour exposures.

(e) The AIHA defines ERPG-1 as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

The DOE defines TEEL-1 as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

(f) For this study, AEGLs were used first when available since they are developed specifically for the purposes of acute exposure evaluations. ERPGs were selected next, prior to a substance's TEEL, because they are vigorously reviewed before they are published whereas the TEELs are not. Example 7 shows a sample calculation of how a substance's estimated acute concentration is compared to its acute toxicity value.

Example 7
Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:

$$\frac{C_{acute(HCl)}}{ATV} = \frac{7.28E-02}{4.47E+03}$$

$$= 1.63E\text{-}05 < 1$$

In this example with HCl, the ratio is five orders of magnitude below 1, indicating that further analysis is not necessary.

6. RISK CHARACTERIZATION

Appendix D presents results from the red-colored M18 risk characterization. Note that for some substances, two concentrations were reported because of different analytical test methods (as noted in bold). In those instances, the higher concentration was used.

a. CHRONIC HEALTH RISK

The outcome indicated that no chronic health risks are expected from breathing the air emissions from the red-colored M18. Since all ratios were below one, no further evaluation was needed.

b. ACUTE HEALTH RISK

For the acute analysis, all ratios were below one, indicating that no acute health impacts are expected from breathing the air emissions from the red-colored M18. Since all ratios for the acute evaluation were below one, no further assessment was needed.

c. FACT SHEET

A copy of the fact sheet submitted to AEC is included as Appendix E. The fact sheet uses the results from this study to address health concerns related to inhalation of red-colored M18 air emissions.

7. UNCERTAINTY DISCUSSION

The limitations inherent in modeling and the added conservatism of the evaluation contribute to the uncertainty of the study results. The risk assessment methodology typically includes safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as the sick, elderly, and children. Table 7 identifies areas of uncertainty associated with this assessment.

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Modeling		
Modeled versus real-time sampling	The air concentrations in this study were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Frequency of use for the red-colored M18	Actual frequency of use of red-colored M18s during a training event may be different from those stated in this report.	Varies
Hypothetical resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Use of worst-case meteorological conditions	To ensure that this study is applicable to most training areas, worst-case meteorological conditions were used in the air model.	Overestimates
Exposure Assessment		
Estimating time-averaged concentrations	Actual exposure from the red-colored M18 is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of the potential for health risks as a function of time, a single concentration, averaged over the exposure duration was used. In this study, the exposure durations used were 30 years and 1-hour or 15 minutes.	Varies
Chromium speciation	All chromium was assumed to be present as Cr(VI), which is more toxic than Cr(III).	Overestimates

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Comparing estimated concentration to established screening levels	The Region 3 and Region 9 HBSLs were developed using different exposure assumptions than those in this study, resulting in more conservative screening levels.	Overestimates
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies
Exposure to other munitions	Other munitions are typically used during the same training event. These items may contain similar or different substances from those detected in the red-colored M18.	Underestimates
Toxicity Assessment		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to conservatively account for extrapolating from animal studies for human health evaluation, and to conservatively account for variation in human populations.	Overestimates

8. CONCLUSION

Results indicated that residents who live as close as 100 meters directly downwind from training areas are safe from breathing air emissions from the red-colored M18. It is believed that the assumptions contained in this analysis are conservative enough to be protective of all the population including the sick, elderly, and children.

9. RECOMMENDATIONS

Since the results from this study are intended for a hypothetical training facility, they can vary depending on site-specific conditions. However, because of the conservative assumptions used (e.g., worst-case meteorological conditions, receptor located directly downwind, etc.) it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this evaluation should be applicable to most training facilities unless site-specific conditions vary significantly.

10. POINT OF CONTACT

Questions about this report may be directed to Ms. Hsieng-Ye Chang at (800) 222-9698 (ext 2953) or (410) 436-2953.

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APPENDIX A

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APPENDIX B

AIR DISPERSION MODELING OUTPUT DATA

Table B-1: Air Modeling Output Data for Metals, Particulates, and Miscellaneous Compounds

	Red Smoke Grenade				Number of Items (I):	1	Item
	NEW, lb = 0.72				Release duration (t):	120	seconds
	Number of Items = 1				Unit Concentration (UC):	3.51E-03	g/m^3
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item (grams/m^3) CONC	Pollutant Emission Rate for One Item (g/sec) ER$_1$
Particulate							
TSP	3.101E+03	9.029E+00	2.097E-01	1.510E-01	6.847E+01	2.003E-03	5.706E-01
HCl/Cl$_2$							
HCl (a)	7.650E-02	7.638E-02	3.812E-06	2.745E-06	1.245E-03	3.642E-08	1.037E-05
Cl2 (a)	5.982E-02	5.654E-02	2.224E-07	1.601E-07	7.263E-05	2.125E-09	6.053E-07
Dioxin/Furan							
Dioxin TEQ (c)	4.753E-07	ND	3.231E-11	2.327E-11	1.055E-08	3.087E-13	8.795E-11
CEM System							
Carbon Monoxide (CO)	1.172E+02	-6.639E-01	8.030E-03	5.782E-03	2.623E+00	7.672E-05	2.185E-02
Nitrogen Oxide (NOx)	8.659E+00	3.827E-02	5.869E-04	4.225E-04	1.917E-01	5.607E-06	1.597E-03
HCl (a)	1.543E+00	2.995E-02	9.440E-05	6.796E-05	3.083E-02	9.018E-07	2.569E-04
Carbon Dioxide (CO2)	2.275E+03	7.028E+02	1.070E-01	7.703E-02	3.494E+01	1.022E-03	2.912E-01
Sulfur Dioxide (SO2)	9.004E+00	5.857E-03	6.040E-04	4.349E-04	1.972E-01	5.770E-06	1.644E-03
Particulate-phase Metals							
Aluminum	1.063E+00	NM (b)	7.199E-05	5.183E-05	2.351E-02	6.878E-07	1.959E-04
Antimony	1.517E-02	NM (b)	1.038E-06	7.471E-07	3.389E-04	9.914E-09	2.824E-06
Arsenic	ND	NM (b)	ND	ND	ND	ND	ND
Barium	1.051E-02	NM (b)	7.165E-07	5.158E-07	2.340E-04	6.845E-09	1.950E-06
Beryllium	3.290E-03	NM (b)	2.251E-07	1.621E-07	7.351E-05	2.150E-09	6.126E-07
Cadmium	ND	NM (b)	ND	ND	ND	ND	ND
Chromium	8.513E-03	NM (b)	5.789E-07	4.168E-07	1.891E-04	5.531E-09	1.576E-06
Cobalt	2.781E-03	NM (b)	1.887E-07	1.359E-07	6.163E-05	1.803E-09	5.136E-07
Copper	ND	NM (b)	ND	ND	ND	ND	ND
Lead	4.105E-01	NM (b)	2.788E-05	2.007E-05	9.105E-03	2.664E-07	7.588E-05
Magnesium	2.415E-01	NM (b)	1.647E-05	1.186E-05	5.380E-03	1.574E-07	4.484E-05
Manganese	8.665E-03	NM (b)	5.890E-07	4.241E-07	1.923E-04	5.627E-09	1.603E-06
Nickel	9.106E-03	NM (b)	6.191E-07	4.457E-07	2.022E-04	5.915E-09	1.685E-06
Phosphorus	ND	NM (b)	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for Metals, Particulates, and Miscellaneous Compounds

	Red Smoke Grenade				Number of Items (I):	1	Item
	NEW, lb = 0.72				Release duration (t):	120	seconds
	Number of Items = 1				Unit Concentration (UC):	3.51E-03	g/m^3
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Selenium	ND	NM (b)	ND	ND	ND	ND	ND
Silver	ND	NM (b)	ND	ND	ND	ND	ND
Thallium	ND	NM (b)	ND	ND	ND	ND	ND
Zinc	1.933E-01	NM (b)	1.319E-05	9.498E-06	4.308E-03	1.260E-07	3.590E-05
Mercury	4.110E-03	NM (b)	2.776E-07	1.999E-07	9.066E-05	2.652E-09	7.555E-07

Footnotes:
ND = Not Detected
NEW = Net Explosive Weight
NM = Not Measureable
CEM = Continuous Emissions Monitoring
(a) HCl/Cl_2 levels were too low to be reliably measured (except for White Smoke)
(b) Insufficient material to analyze.
(c) Presence questionable - reported at similar levels in samples and blanks.

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

	Red Smoke Grenade				Number of Items (I):	1	Item
	NEW, lb = 0.72				Release duration (t):	120	seconds
	Number of Items = 1				Unit Concentration (UC):	3.51E-03	g/m^3
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item (grams/m^3) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Total Nonmethane Hydrocarbons (TNMHC)							
TNMHC	1.019E+01	2.919E-01	7.042E-04	5.070E-04	2.300E-01	6.727E-06	1.916E-03
Volatile Organic Compounds (VOCs)							
Ethane	2.950E-02	1.350E-03	1.999E-06	1.440E-06	6.530E-04	1.910E-08	5.441E-06
Ethylene	1.143E+00	3.500E-04	8.095E-05	5.829E-05	2.644E-02	7.734E-07	2.203E-04
Acetylene	1.728E+00	9.000E-04	1.229E-04	8.847E-05	4.013E-02	1.174E-06	3.344E-04
Propane	8.500E-03	1.200E-03	5.177E-07	3.727E-07	1.691E-04	4.946E-09	1.409E-06
Propene	2.940E-01	1.500E-04	2.083E-05	1.500E-05	6.802E-03	1.990E-07	5.668E-05
i-Butane	1.000E-03	4.000E-04	5.024E-08	3.618E-08	1.641E-05	4.800E-10	1.367E-07
i-Butene	3.950E-02	1.000E-04	2.790E-06	2.009E-06	9.111E-04	2.665E-08	7.593E-06
1-Butene	6.100E-02	ND	4.323E-06	3.113E-06	1.412E-03	4.130E-08	1.176E-05
1,3-Butadiene	1.500E-03	ND	1.062E-07	7.648E-08	3.469E-05	1.015E-09	2.891E-07
n-Butane	3.500E-03	7.000E-04	1.981E-07	1.426E-07	6.469E-05	1.893E-09	5.391E-07
trans-2-Butene	5.600E-02	ND	3.939E-06	2.836E-06	1.286E-03	3.763E-08	1.072E-05
2,2-Dimethylpropane	ND	ND	ND	ND	ND	ND	ND
cis-2-Butene	1.300E-02	ND	9.144E-07	6.583E-07	2.986E-04	8.736E-09	2.488E-06
3-Methyl-1-butene	1.000E-02	ND	7.034E-07	5.064E-07	2.297E-04	6.720E-09	1.914E-06
i-Pentane	ND	1.400E-03	ND	ND	ND	ND	ND
1-Pentene	2.950E-02	ND	2.091E-06	1.505E-06	6.828E-04	1.997E-08	5.690E-06
2-Methyl-1-butene	1.700E-02	ND	1.196E-06	8.609E-07	3.905E-04	1.142E-08	3.254E-06
n-Pentane	ND	1.200E-03	ND	ND	ND	ND	ND
Isoprene	ND	1.000E-04	ND	ND	ND	ND	ND
trans-2-Pentene	1.700E-02	ND	1.196E-06	8.609E-07	3.905E-04	1.142E-08	3.254E-06
cis-2-Pentene	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2-butene	ND	ND	ND	ND	ND	ND	ND
2,2-Dimethylbutane	ND	2.500E-04	ND	ND	ND	ND	ND
Cyclopentene	ND	ND	ND	ND	ND	ND	ND
4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND
Cyclopentane	ND	1.500E-04	ND	ND	ND	ND	ND
2,3-Dimethylbutane	ND	3.000E-04	ND	ND	ND	ND	ND
cis-4-Methyl-2-pentene	ND	ND	ND	ND	ND	ND	ND
2-Methylpentane	ND	1.350E-03	ND	ND	ND	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
3-Methylpentane	ND	7.500E-04	ND	ND	ND	ND	ND
2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND
1-Hexene	3.650E-02	ND	2.590E-06	1.865E-06	8.457E-04	2.474E-08	7.048E-06
n-Hexane	ND	1.500E-03	ND	ND	ND	ND	ND
trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2-pentene	ND	ND	ND	ND	ND	ND	ND
cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND
Methylcyclopentane	ND	4.500E-04	ND	ND	ND	ND	ND
2,4-Dimethylpentane	ND	ND	ND	ND	ND	ND	ND
Benzene	3.210E-01	1.450E-03	2.271E-05	1.635E-05	7.418E-03	2.170E-07	6.182E-05
Cyclohexane	ND	4.000E-04	ND	ND	ND	ND	ND
2-Methylhexane	ND	5.000E-04	ND	ND	ND	ND	ND
2,3-Dimethylpentane	ND	2.500E-04	ND	ND	ND	ND	ND
3-Methylhexane	ND	8.000E-04	ND	ND	ND	ND	ND
2,2,4-Trimethylpentane	ND	5.500E-04	ND	ND	ND	ND	ND
n-Heptane	ND	7.000E-04	ND	ND	ND	ND	ND
2,4,4-Trimethyl-1-pentene	ND	ND	ND	ND	ND	ND	ND
Methylcyclohexane	ND	5.500E-04	ND	ND	ND	ND	ND
2,4,4-Trimethyl-2-pentene	ND	ND	ND	ND	ND	ND	ND
2,5-Dimethylhexane	ND	1.000E-04	ND	ND	ND	ND	ND
2,4-Dimethylhexane	ND	1.000E-04	ND	ND	ND	ND	ND
2,3,4-Trimethylpentane	ND	1.500E-04	ND	ND	ND	ND	ND
Toluene	3.650E-02	2.950E-03	2.384E-06	1.716E-06	7.784E-04	2.277E-08	6.487E-06
2,3-Dimethylhexane	ND	1.000E-04	ND	ND	ND	ND	ND
2-Methylheptane	ND	1.000E-04	ND	ND	ND	ND	ND
3-Ethylhexane	ND	1.500E-04	ND	ND	ND	ND	ND
2,2-Dimethylheptane	ND	ND	ND	ND	ND	ND	ND
2,2,4-Trimethylhexane	ND	ND	ND	ND	ND	ND	ND
n-Octane	ND	1.500E-04	ND	ND	ND	ND	ND
Ethylcyclohexane	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	2.250E-02	1.035E-02	8.641E-07	6.221E-07	2.822E-04	8.255E-09	2.352E-06
m-Xylene & p-Xylene	1.200E-01	4.270E-02	5.498E-06	3.959E-06	1.796E-03	5.253E-08	1.496E-05
Styrene	ND	ND	ND	ND	ND	ND	ND
o-Xylene	2.100E-02	1.390E-02	5.046E-07	3.633E-07	1.648E-04	4.821E-09	1.373E-06
n-Nonane	ND	ND	ND	ND	ND	ND	ND
i-Propylbenzene	ND	ND	ND	ND	ND	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
n-Propylbenzene	ND	1.000E-04	ND	ND	ND	ND	ND
p-Ethyltoluene	ND	ND	ND	ND	ND	ND	ND
m-Ethyltoluene	ND	2.000E-04	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	2.000E-04	ND	ND	ND	ND	ND
o-Ethyltoluene	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene & sec-Butylbenzene	ND	4.500E-04	ND	ND	ND	ND	ND
n-Decane	2.050E-02	ND	1.458E-06	1.050E-06	4.761E-04	1.393E-08	3.967E-06
alpha-Pinene	ND	ND	ND	ND	ND	ND	ND
beta-Pinene	ND	ND	ND	ND	ND	ND	ND
delta 3-Carene	ND	ND	ND	ND	ND	ND	ND
d-Limonene	ND	ND	ND	ND	ND	ND	ND
MTBE	ND	4.500E-04	ND	ND	ND	ND	ND
Dichlorodifluoromethane	5.631E-03	2.557E-03	2.202E-07	1.586E-07	7.193E-05	2.104E-09	5.994E-07
Methylchloride	ND	ND	ND	ND	ND	ND	ND
Dichlorotetrafluoroethane	ND	9.179E-04	ND	ND	ND	ND	ND
Chloroethene	4.006E-02	ND	2.848E-06	2.050E-06	9.301E-04	2.721E-08	7.751E-06
1,3-Butadiene	1.526E-03	ND	1.080E-07	7.779E-08	3.529E-05	1.032E-09	2.940E-07
Methylbromide	ND	ND	ND	ND	ND	ND	ND
Ethylchloride	2.959E-03	ND	2.096E-07	1.509E-07	6.846E-05	2.003E-09	5.705E-07
Trichloromonofluoromethane	2.416E-03	2.577E-03	ND	ND	ND	ND	ND
Vinylidenechloride	7.841E-03	ND	5.566E-07	4.007E-07	1.818E-04	5.317E-09	1.515E-06
Methylenechloride	4.834E-02	1.560E-03	3.321E-06	2.391E-06	1.085E-03	3.173E-08	9.039E-06
Allylchloride	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	6.364E-04	8.293E-04	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene	9.459E-03	ND	6.723E-07	4.841E-07	2.196E-04	6.423E-09	1.830E-06
Chloroform	2.605E-01	ND	1.849E-05	1.331E-05	6.039E-03	1.767E-07	5.033E-05
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
Methylchloroform	ND	2.960E-04	ND	ND	ND	ND	ND
Benzene	3.265E-01	1.475E-03	2.310E-05	1.663E-05	7.545E-03	2.207E-07	6.288E-05
Carbontetrachloride	1.109E-02	7.544E-04	7.346E-07	5.289E-07	2.399E-04	7.018E-09	1.999E-06
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	8.613E-03	ND	6.123E-07	4.408E-07	2.000E-04	5.849E-09	1.666E-06
cis 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	ND	ND
trans 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Toluene	3.712E-02	3.001E-03	2.424E-06	1.746E-06	7.918E-04	2.316E-08	6.598E-06
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND
Perchloroethylene	1.319E-02	7.490E-04	8.826E-07	6.355E-07	2.882E-04	8.432E-09	2.402E-06
Chlorobenzene	2.471E-02	ND	1.757E-06	1.265E-06	5.739E-04	1.679E-08	4.782E-06
Ethylbenzene	3.454E-02	1.589E-02	1.327E-06	9.552E-07	4.333E-04	1.267E-08	3.610E-06
m&p-Xylene	1.221E-01	4.343E-02	5.592E-06	4.026E-06	1.826E-03	5.342E-08	1.522E-05
Styrene	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND
o-Xylene	2.136E-02	1.414E-02	5.133E-07	3.696E-07	1.676E-04	4.904E-09	1.397E-06
p-Ethyltoluene	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	ND	4.577E-04	ND	ND	ND	ND	ND
Benzylchloride	ND	ND	ND	ND	ND	ND	ND
m-Dichlorobenzene	2.205E-03	ND	1.565E-07	1.127E-07	5.112E-05	1.495E-09	4.260E-07
p-Dichlorobenzene	1.592E-03	ND	1.131E-07	8.144E-08	3.694E-05	1.081E-09	3.078E-07
o-Dichlorobenzene	2.263E-02	ND	1.609E-06	1.159E-06	5.256E-04	1.537E-08	4.380E-06
1,2,4-Trichlorobenzene	1.007E-03	ND	7.229E-08	5.205E-08	2.361E-05	6.907E-10	1.968E-07
Hexachlorobutadiene	2.451E-02	ND	1.747E-06	1.258E-06	5.706E-04	1.669E-08	4.755E-06
Phenylacetylene	2.054E-02	ND	1.465E-06	1.055E-06	4.785E-04	1.400E-08	3.987E-06
d-Limonene	5.582E-03	7.040E-03	ND	ND	ND	ND	ND
Methylnitrite	2.856E-02	ND	2.034E-06	1.464E-06	6.643E-04	1.943E-08	5.536E-06
Acetonitrile	5.789E-02	2.618E-04	4.092E-06	2.946E-06	1.336E-03	3.909E-08	1.114E-05
Acrylonitrile	1.903E-02	ND	1.353E-06	9.744E-07	4.420E-04	1.293E-08	3.683E-06
Nitromethane	1.716E-02	ND	1.220E-06	8.783E-07	3.984E-04	1.165E-08	3.320E-06
Benzonitrile	7.792E-02	2.153E-03	5.384E-06	3.877E-06	1.758E-03	5.144E-08	1.465E-05
Nitrobenzene	2.594E-02	ND	1.862E-06	1.341E-06	6.081E-04	1.779E-08	5.068E-06
4-Methylbenzonitrile	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	7.085E+00	2.237E-03	5.032E-04	3.623E-04	1.643E-01	4.807E-06	1.369E-03
Thiophene	4.615E-01	ND	3.279E-05	2.361E-05	1.071E-02	3.133E-07	8.924E-05
Dimethyldisulfide	1.702E-01	ND	1.213E-05	8.730E-06	3.960E-03	1.158E-07	3.300E-05
2-Methylthiophene	2.276E-02	ND	1.614E-06	1.162E-06	5.272E-04	1.542E-08	4.393E-06
3-Methylthiophene	1.934E-02	ND	1.370E-06	9.865E-07	4.475E-04	1.309E-08	3.729E-06
Dimethyltrisulfide	2.521E-01	ND	1.787E-05	1.287E-05	5.837E-03	1.707E-07	4.864E-05
1-Chlorobutane	ND	ND	ND	ND	ND	ND	ND
1-Bromo-2-chloroethane	ND	ND	ND	ND	ND	ND	ND
2-Bromo-1-chloropropane	ND	ND	ND	ND	ND	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
1,2-Dichlorobutane	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND
1-Chloro-2-methylbenzene	1.901E+00	ND	1.354E-04	9.748E-05	4.422E-02	1.293E-06	3.685E-04
1-Chloro-3-methylbenzene	1.564E-01	ND	1.115E-05	8.026E-06	3.640E-03	1.065E-07	3.034E-05
1-Chloro-4-ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Pentachloro-1-propene	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	1.317E-02	ND	9.261E-07	6.668E-07	3.024E-04	8.848E-09	2.520E-06
1,2-Dichloro-3-methylbenzene	ND	ND	ND	ND	ND	ND	ND
Carbonyl Sulfide	6.600E-02	ND	4.691E-06	3.378E-06	1.532E-03	4.482E-08	1.277E-05
Trichloroacetonitrile	ND	ND	ND	ND	ND	ND	ND
Dichloroacetonitrile	2.291E-02	ND	1.629E-06	1.173E-06	5.320E-04	1.556E-08	4.434E-06
Isothiocyanatomethane	1.237E-01	ND	8.784E-06	6.324E-06	2.869E-03	8.392E-08	2.391E-05
1,1-Dichloro-2-propanone	ND	ND	ND	ND	ND	ND	ND
2-Thiophenecarboxaldehyde	2.243E-02	1.311E-03	1.554E-06	1.119E-06	5.074E-04	1.484E-08	4.228E-06
Acetaldehyde	8.927E-01	ND	6.348E-05	4.571E-05	2.073E-02	6.065E-07	1.728E-04
Ethanol	1.864E-02	7.082E-04	1.269E-06	9.139E-07	4.145E-04	1.213E-08	3.454E-06
Acrolein	5.075E-01	8.406E-04	3.625E-05	2.610E-05	1.184E-02	3.463E-07	9.865E-05
Acetone	2.148E+00	4.208E-01	1.224E-04	8.813E-05	3.998E-02	1.169E-06	3.331E-04
Propanal	ND	ND	ND	ND	ND	ND	ND
Furan	1.275E-01	ND	9.057E-06	6.521E-06	2.958E-03	8.653E-08	2.465E-05
2-Propanol	8.166E-03	4.501E-03	2.613E-07	1.882E-07	8.534E-05	2.497E-09	7.112E-07
Methacrolein	4.207E-02	ND	2.993E-06	2.155E-06	9.775E-04	2.860E-08	8.146E-06
MTBE	ND	8.996E-04	ND	ND	ND	ND	ND
Methyl-vinyl ketone	8.345E-02	1.724E-04	5.956E-06	4.288E-06	1.945E-03	5.690E-08	1.621E-05
2,3-Butanedione	1.547E-01	ND	1.102E-05	7.931E-06	3.597E-03	1.052E-07	2.998E-05
Butanal	2.649E-02	3.930E-04	1.857E-06	1.337E-06	6.063E-04	1.774E-08	5.053E-06
2-Butanone	7.521E-02	6.697E-03	4.865E-06	3.503E-06	1.589E-03	4.648E-08	1.324E-05
2-Methylfuran	7.434E-03	ND	5.229E-07	3.765E-07	1.708E-04	4.995E-09	1.423E-06
3-Methylfuran	ND	ND	ND	ND	ND	ND	ND
trans-2-Butenal	1.364E-01	ND	9.746E-06	7.017E-06	3.183E-03	9.311E-08	2.652E-05
Tetrahydrofuran	ND	1.444E-03	ND	ND	ND	ND	ND
3-Methyl-2-butanone	ND	ND	ND	ND	ND	ND	ND
Acetic Acid	1.570E-02	4.931E-04	1.087E-06	7.828E-07	3.551E-04	1.039E-08	2.959E-06
1-Butanol	1.697E-02	8.710E-04	1.144E-06	8.237E-07	3.736E-04	1.093E-08	3.113E-06
1-Penten-3-one	ND	ND	ND	ND	ND	ND	ND
2-Pentanone	9.176E-03	ND	6.502E-07	4.682E-07	2.124E-04	6.212E-09	1.770E-06

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Pentanal	ND	ND	ND	ND	ND	ND	ND
2.3-Pentanedione	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloro-2-methylpropane	ND	ND	ND	ND	ND	ND	ND
3-Pentanone	ND	ND	ND	ND	ND	ND	ND
2.5-Dimethylfuran	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	1.909E-02	ND	1.357E-06	9.769E-07	4.431E-04	1.296E-08	3.693E-06
trans-3-Penten-2-one	ND	ND	ND	ND	ND	ND	ND
Cyclopentanone	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND
Hexanal	2.998E-02	6.758E-04	2.089E-06	1.504E-06	6.823E-04	1.996E-08	5.686E-06
3-Furaldehyde	1.143E-01	3.472E-04	8.105E-06	5.835E-06	2.647E-03	7.743E-08	2.206E-05
2-Cyclopenten-1-one	ND	ND	ND	ND	ND	ND	ND
2-Furaldehyde	3.019E-01	1.711E-03	2.134E-05	1.536E-05	6.969E-03	2.039E-07	5.808E-05
1-Acetoxyacetone	ND	ND	ND	ND	ND	ND	ND
2-Heptanone	3.783E-03	ND	2.691E-07	1.938E-07	8.789E-05	2.571E-09	7.324E-07
Heptanal	8.146E-03	7.655E-04	5.249E-07	3.780E-07	1.714E-04	5.015E-09	1.429E-06
5-Methyl-2-furaldehyde	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	1.149E-01	1.603E-03	8.074E-06	5.814E-06	2.637E-03	7.714E-08	2.197E-05
Benzofuran	3.352E-02	ND	2.382E-06	1.715E-06	7.779E-04	2.276E-08	6.483E-06
Octanal	1.166E-02	1.216E-03	7.427E-07	5.347E-07	2.425E-04	7.095E-09	2.021E-06
Acetophenone	ND	ND	ND	ND	ND	ND	ND
2-Nonanone	ND	ND	ND	ND	ND	ND	ND
Nonanal	1.010E-02	7.861E-04	6.637E-07	4.778E-07	2.167E-04	6.340E-09	1.806E-06

Footnotes:
ND = Not Detected
NEW = Net Explosive Weight
Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

	Red Smoke Grenade				Number of Items (I):	1	Item
	NEW, lb = 0.72				Release duration (t):	120	seconds
	Number of Items = 1				Unit Concentration (UC):	3.51E-03	g/m^3
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (grams/sec) ER_1
Particulate/Vapor-phase SVOCs							
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomethylethylamine	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiethylamine	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND
Pentachloroethane	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND
o-Toluidine	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol/3-Methylphenol	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND
Acetophenone	ND	3.435E-03	ND	ND	ND	ND	ND
N-Nitrosomorpholine	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopyrrolidine	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (grams/sec) ER_1
Benzoic acid	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND
p-Chloroaniline	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND
Hexachloropropene	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND
Dimethylphenethylamine	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND
Safrole	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND
Isosafrole	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND	ND
1,4-Naphthoquinone	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (grams/sec) ER_1
Diethylphthalate	ND	1.041E-03	ND	ND	ND	ND	ND
4-Chlorophenylphenyl ether	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND
5-Nitro-o-toluidine	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND
Diphenylamine/N-NitrosoDPA	ND	ND	ND	ND	ND	ND	ND
sym-Trinitrobenzene	ND	ND	ND	ND	ND	ND	ND
Diallate	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND
4-Bromophenylphenyl ether	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	5.860E-03	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND
4-Nitroquinoline-1-oxide	ND	ND	ND	ND	ND	ND	ND
Methapyrilene	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND	ND
Kepone	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND
3,3'-Dimethylbenzidine	ND	ND	ND	ND	ND	ND	ND
2-Acetylaminofluorene	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	1.124E-02	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted Per Item (grams) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (grams/sec) ER_1
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND
7,12-Dimethylbenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND
Benz(a)pyrene	ND	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	ND
Particulate/Vapor-phase SVOCs (Tentatively Identified Compounds)							
2-(2-quinolinyl)-(H-indene-1,3-(2H)-dione (a)	ND	ND	ND	ND	ND	ND	ND
Benzanthrone (b)	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND
(1,2-dichloroethyl)-benzene	ND	ND	ND	ND	ND	ND	ND
4-phenoxy-2(1H)-quinolinone (a)	ND	ND	ND	ND	ND	ND	ND
3-(phenylhydrazone)-1H-Indole-2,3-dione	1.264E+03	ND	8.581E-02	6.178E-02	2.802E+01	8.198E-04	2.335E-01
4-1,2,4-oxadizaolin-3-one-2,5-diphenyl-delta	ND	ND	ND	ND	ND	ND	ND
2-amino-9,10-anthracenedione (a)	5.192E+01	ND	3.526E-03	2.538E-03	1.151E+00	3.368E-05	9.595E-03

Footnotes:
ND = Not Detected
NEW = Net Explosive Weight

APPENDIX C

HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
Compound	CAS #	Region 9 PRG (µg/m³)	Toxicity Endpoint (Cancer/nc)	Region 3 RBC (µg/m³)	Toxicity Endpoint (Cancer/nc)	Health-based Screening Level (µg/m³)	ERPG I (µg/m³)	TEEL I (µg/m³)	AEGL I (µg/m³)	Source (A,E or T)	Acute Toxicity Value (µg/m³)
TSP	12789-66-1	5.00E+01		NA		5.00E+01	NA	NA	NA		
HCl	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	NA	4.47E+03	NA	T	4.47E+03
Cl_2	7782-50-5	2.09E-01	nc	3.65E+02	nc	2.09E-01	2.89E+03	2.90E+03	2.90E+03	A	2.90E+03
Dioxin TEQ	1746-01-6	4.48E-08	c	4.17E-08	c	4.48E-08	NA	3.50E+00	NA	T	3.50E+00
Carbon Monoxide (CO)	630-08-0	1.57E+02		NA		1.57E+02	2.30E+05	2.28E+05	NA	E	2.30E+05
Nitrogen Oxide (NOx)	10024-97-2	1.00E+02		NA		1.00E+02	NA	2.70E+05	NA	T	2.70E+05
HCl (CEM System)	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	NA	4.47E+03	NA	T	4.47E+03
Carbon Dioxide (CO_2)	124-38-9	NA		NA		NA	NA	5.40E+07	NA	T	5.40E+07
Sulfur Dioxide (SO_2)	7446-09-5	8.00E+01		NA		8.00E+01	7.89E+02	7.86E+02	NA	E	7.89E+02
Aluminum	7429-90-5	NA		3.65E+00	nc	3.65E+00	NA	3.00E+04	NA	T	3.00E+04
Antimony	7440-36-0	NA		1.46E+00	nc	1.46E+00	NA	1.50E+03	NA	T	1.50E+03
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c	4.47E-04	NA	3.00E+01	NA	T	3.00E+01
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc	5.21E-01	NA	1.50E+03	NA	T	1.50E+03
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c	8.00E-04	NA	5.00E+00	NA	T	5.00E+00
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c	1.07E-03	NA	3.00E+01	NA	T	3.00E+01
Chromium	7440-47-3	NA	c	1.53E-04	c	1.53E-04	NA	1.50E+03	NA	T	1.50E+03
Cobalt	7440-48-4	NA		2.20E+02	nc	2.20E+02	NA	6.00E+01	NA	T	6.00E+01
Copper	7440-50-8	NA		1.46E+02	nc	1.46E+02	NA	3.00E+03	NA	T	3.00E+03
Lead	7439-92-1	1.50E+00		NA		1.50E+00	NA	1.50E+02	NA	T	1.50E+02
Magnesium	7439-95-4	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc	5.11E-02	NA	3.00E+03	NA	T	3.00E+03
Nickel	7440-02-0	NA		7.30E+01	nc	7.30E+01	NA	3.00E+03	NA	T	3.00E+03
Phosphorus	7723-14-0	NA		NA		NA	NA	3.00E+02	NA	T	3.00E+02
Selenium	7782-49-2	NA		1.83E+01	nc	1.83E+01	NA	6.00E+02	NA	T	6.00E+02
Silver	7740-22-4	NA		1.83E+01	nc	1.83E+01	NA	3.00E+02	NA	T	3.00E+02
Thallium	7440-28-0	NA		2.56E-01	nc	2.56E-01	NA	3.00E+02	NA	T	3.00E+02
Zinc	7440-66-6	NA		1.10E+03	nc	1.10E+03	NA	3.00E+04	NA	T	3.00E+04
Mercury	7439-97-6	3.13E-01	nc	3.14E-01	nc	3.13E-01	NA	1.00E+02	NA	T	1.00E+02
TNMHC		NA		NA		NA	NA	NA	NA		
Ethane	74-84-0	NA		NA		NA	NA	NA	NA		
Ethylene	74-85-1	NA		NA		NA	NA	4.60E+05	NA	T	4.60E+05
Acetylene	74-86-2	NA		NA		NA	NA	NA	NA		
Propane	74-98-6	NA		NA		NA	NA	3.78E+06	NA	T	3.78E+06
Propene	115-07-1	NA		NA		NA	NA	NA	NA		
i-Butane	106-97-8	NA		NA		NA	NA	5.71E+06	NA	T	5.71E+06
i-Butene	25167-67-3	NA		NA		NA	NA	NA	NA		
1-Butene	106-98-9	NA		NA		NA	NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS	For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
		Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m³)	Toxicity Endpoint (c or nc)	Health-based screening level (µg/m³)	EREG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (A, E, T)	Acute Toxicity Value (µg/m³)
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	NA	E	2.20E+04
n-Butane	106-97-8	NA		NA		NA	NA	5.71E+06	NA	T	5.71E+06
trans-2-Butene	624-64-6	NA		NA		NA	NA	NA	NA		
2,2-Dimethylpropane	463-82-1	NA		NA		NA	NA	NA	NA		
cis-2-Butene	590-18-1	NA		NA		NA	NA	NA	NA		
3-Methyl-1-butene	563-45-1	NA		NA		NA	NA	NA	NA		
I-Pentane	109-66-0	NA		NA		NA	NA	1.80E+06	NA	T	1.80E+06
1-Pentene	109-67-1	NA		NA		NA	NA	NA	NA		
2-Methyl-1-butene	563-46-2	NA		NA		NA	NA	NA	NA		
n-Pentane	109-66-0	NA		NA		NA	NA	1.80E+06	NA	T	1.80E+06
Isoprene	78-79-5	NA		NA		NA	NA	NA	NA		
trans-2-Pentene	646-04-8	NA		NA		NA	NA	NA	NA		
cis-2-Pentene	627-20-3	NA		NA		NA	NA	NA	NA		
2-Methyl-2-butene	513-35-9	NA		NA		NA	NA	NA	NA		
2,2-Dimethylbutane	75-83-2	NA		NA		NA	NA	1.80E+06	NA	T	1.80E+06
Cyclopentene	142-29-0	NA		NA		NA	NA	NA	NA		
4-Methyl-1-pentene	691-37-2	NA		NA		NA	NA	NA	NA		
Cyclopentane	287-92-3	NA		NA		NA	NA	NA	NA		
2,3-Dimethylbutane	79-29-8	NA		NA		NA	NA	NA	NA		
cis-4-Methyl-2-pentene	691-38-3	NA		NA		NA	NA	NA	NA		
2-Methylpentane	107-83-5	NA		NA		NA	NA	1.80E+06	NA	T	1.80E+06
3-Methylpentane	96-14-0	NA		NA		NA	NA	NA	NA		
2-Methyl-1-pentene	763-29-1	NA		NA		NA	NA	NA	NA		
1-Hexene	592-41-6	NA		NA		NA	NA	1.03E+05	NA	T	1.03E+05
n-Hexane	110-54-3	2.10E+02	nc	2.08E+02	nc	2.10E+02	NA	5.28E+05	NA	T	5.28E+05
trans-2-Hexene	4050-45-7	NA		NA		NA	NA	NA	NA		
2-Methyl-2-pentene	625-27-4	NA		NA		NA	NA	NA	NA		
cis-2-Hexene	7688-21-3	NA		NA		NA	NA	NA	NA		
Methylcyclopentane	96-37-7	NA		NA		NA	NA	NA	NA		
2,4-Dimethylpentane	108-08-7	NA		NA		NA	NA	NA	NA		
Benzene	71-43-2	2.50E-01	c	2.16E-01	c	2.50E-01	1.56E+05	1.60E+05	NA	E	1.56E+05
Cyclohexane	110-82-7	NA		NA		NA	NA	3.10E+06	NA	T	3.10E+06
2-Methylhexane	591-76-4	NA		NA		NA	NA	NA	NA		
2,3-Dimethylpentane	565-59-3	NA		NA		NA	NA	NA	NA		
3-Methylhexane	589-34-4	NA		NA		NA	NA	NA	NA		
2,2,4-Trimethylpentane	540-84-1	NA		NA		NA	NA	3.50E+05	NA	T	3.50E+05
n-Heptane	142-82-5	NA		NA		NA	NA	1.80E+06	NA	T	1.80E+06
2,4,4-Trimethyl-1-pentene	107-39-1	NA		NA		NA	NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
Compound	CAS #	Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m³)	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m³)	ERPG-2 (µg/m³)	TEEL-2 (µg/m³)	AEGL-2 (µg/m³)	Source (AEGL or TEEL)	Acute Toxicity Value (µg/m³)
Methylcyclohexane	108-87-2	3.10E+03	nc	3.14E+03	nc	3.10E+03	NA	4.81E+06	NA	T	4.81E+06
2,4,4-Trimethyl-2-pentene	107-40-4	NA		NA		NA	NA	NA	NA		
2,5-Dimethylhexane	592-13-2	NA		NA		NA	NA	NA	NA		
2,4-Dimethylhexane	589-43-5	NA		NA		NA	NA	NA	NA		
2,3,4-Trimethylpentane	565-59-3	NA		NA		NA	NA	NA	NA		
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	NA	E	1.88E+05
2,3-Dimethylhexane	584-94-1	NA		NA		NA	NA	NA	NA		
2-Methylheptane	592-27-8	NA		NA		NA	NA	NA	NA		
3-Ethylhexane	619-99-8	NA		NA		NA	NA	NA	NA		
2,2-Dimethylheptane	1071-26-7	NA		NA		NA	NA	NA	NA		
2,2,4-Trimethylhexane	16747-26-5	NA		NA		NA	NA	NA	NA		
n-Octane	111-65-9	NA		NA		NA	NA	NA	NA		
Ethylcyclohexane	1678-91-7	NA		NA		NA	NA	NA	NA		
Ethylbenzene	100-41-4	1.10E+03	nc	1.06E+03	nc	1.10E+03	NA	5.43E+05	NA	T	5.43E+05
m-Xylene & p-Xylene	108-38-3	NA		NA		NA	NA	6.51E+05	NA	T	6.51E+05
Styrene	100-42-5	1.10E+03	nc	1.04E+03	nc	1.10E+03	2.13E+05	2.13E+05	NA	E	2.13E+05
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02	NA	6.51E+05	NA	T	6.51E+05
n-Nonane	111-84-2	NA		4.02E+02	nc	4.02E+02	NA	1.05E+06	NA	T	1.05E+06
I-Propylbenzene	98-82-8	4.00E+02	nc	4.02E+02	nc	4.00E+02	NA	7.37E+05	NA	T	7.37E+05
n-Propylbenzene	103-65-1	3.65E+01	nc	1.46E+02	nc	3.65E+01	NA	3.68E+05	NA	T	3.68E+05
p-Ethyltoluene	622-96-8	NA		NA		NA	NA	1.25E+05	NA	T	1.25E+05
m-Ethyltoluene	620-14-4	NA		NA		NA	NA	NA	NA		
1,3,5-Trimethylbenzene	108-67-8	6.20E+00	nc	6.21E+00	nc	6.20E+00	NA	3.68E+05	NA	T	3.68E+05
o-Ethyltoluene	611-14-3	NA		NA		NA	NA	7.50E+02	NA	T	7.50E+02
1,2,4-Trimethylbenzene & sec-Butylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	1.80E+05	NA	T	1.80E+05
n-Decane	124-18-5	NA		NA		NA	NA	4.37E+03	NA	T	4.37E+03
alpha-Pinene	80-56-8	NA		NA		NA	NA	4.00E+04	NA	T	4.00E+04
beta-Pinene	127-91-3	NA		NA		NA	NA	NA	NA		
delta 3-Carene	13466-78-9	NA		NA		NA	NA	NA	NA		
d-Limonene	5989-27-5	NA		NA		NA	NA	3.50E+05	NA	T	3.50E+05
MTBE	1634-04-4	3.10E+03	nc	3.13E+03	nc	3.10E+03	NA	4.32E+05	NA	T	4.32E+05
Dichlorodifluoromethane	75-71-8	2.10E+02	nc	1.83E+02	nc	2.10E+02	NA	1.48E+07	NA	T	1.48E+07
Methylchloride	74-87-33	1.07E+00	c	1.79E+00	c	1.07E+00	NA	NA	NA		
Dichlorotetrafluoroethane	374-07-2	NA		NA		NA	NA	NA	NA		
Chloroethene	75-01-4	2.20E-02	c	2.09E-02	c	2.20E-02	NA	1.28E+04	NA	T	1.28E+04
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	NA	E	2.20E+04
Methylbromide	74-83-9	5.20E+00	nc	5.11E+00	nc	5.20E+00	NA	5.82E+04	NA	T	5.82E+04
Ethylchloride	75-00-3	2.30E+00	c	2.16E+00	c	2.30E+00	NA	7.92E+06	NA	T	7.92E+06

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
		Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m³)	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m³)	ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (A, E or T)	Acute Toxicity Value (µg/m³)
Trichloromonofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	2.81E+06	NA	T	2.81E+06
Vinylidene chloride	75-35-4	3.84E-02	c	3.58E-02	c	3.84E-02	NA	7.92E+04	NA	T	7.92E+04
Methylene chloride	75-09-2	4.10E+00	c	3.79E+00	c	4.10E+00	6.96E+05	6.94E+05	NA	E	6.96E+05
Allyl chloride	107-05-1	1.04E+00	nc	NA		1.04E+00	9.39E+03	9.39E+03	NA	E	9.39E+03
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	3.13E+04	nc	3.14E+04	nc	3.13E+04	NA	9.58E+06	NA	T	9.58E+06
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc	5.21E+02	NA	1.21E+06	NA	T	1.21E+06
1,2-Dichloroethene	540-59-0	NA		3.29E+01	nc	3.29E+01	NA	2.38E+06	5.30E+04	A	5.30E+04
Chloroform	67-66-3	8.35E-02	c	7.73E-02	c	8.35E-02	NA	9.76E+03	NA	T	9.76E+03
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c	7.39E-02	NA	8.08E+03	NA	T	8.08E+03
Methylchloroform	71-55-6	1.04E+03	nc	2.30E+03	nc	1.04E+03	1.94E+06	1.91E+06	NA	E	1.94E+06
Benzene	71-43-2	2.49E-01	c	2.16E-01	c	2.49E-01	NA	1.60E+05	NA	T	1.60E+05
Carbontetrachloride	56-23-5	1.28E-01	nc	1.18E-01	nc	1.28E-01	1.28E+05	1.26E+05	NA	E	1.28E+05
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c	9.89E-02	NA	5.08E+05	NA	T	5.08E+05
Trichloroethylene	79-01-6	1.12E+00	c	1.04E+00	c	1.12E+00	NA	5.37E+05	NA	T	5.37E+05
cis 1,3-Dichloro-1-propene	10061-01-5	NA		NA		NA	NA	1.14E+04	NA	T	1.14E+04
trans 1,3-Dichloro-1-propene	10061-02-6	NA		NA		NA	NA	NA	NA		
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c	1.20E-01	NA	1.64E+05	NA	T	1.64E+05
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	NA	E	1.88E+05
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c	8.73E-03	NA	1.54E+05	NA	T	1.54E+05
Perchloroethylene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00	6.89E+05	6.78E+05	NA	E	6.89E+05
Chlorobenzene	108-90-7	6.20E+01	nc	6.21E+01	nc	6.20E+01	NA	1.38E+05	NA	T	1.38E+05
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03	NA	5.43E+05	NA	T	5.43E+05
m&p-Xylene	108-38-3	7.30E+02	nc	NA		7.30E+02	NA	6.51E+05	NA	T	6.51E+05
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03	2.13E+05	2.13E+05	NA	E	2.13E+05
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c	3.31E-02	NA	2.06E+04	NA	T	2.06E+04
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02	NA	6.51E+05	NA	T	6.51E+05
p-Ethyltoluene	622-96-8	NA		NA		NA	NA	1.25E+05	NA	T	1.25E+05
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	3.68E+05	NA	T	3.68E+05
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	1.80E+05	NA	T	1.80E+05
Benzylchloride	100-44-7	3.96E-02	nc	3.68E-02	c	3.96E-02	5.20E+03	5.17E+03	NA	E	5.20E+03
m-Dichlorobenzene	541-73-1	3.29E+00	nc	3.29E+00	nc	3.29E+00	NA	3.61E+04	NA	T	3.61E+04
p-Dichlorobenzene	106-46-7	3.06E-01	c	2.85E-01	c	3.06E-01	NA	6.61E+05	NA	T	6.61E+05
o-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05	NA	T	3.01E+05
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02	NA	3.71E+04	NA	T	3.71E+04
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02	3.21E+04	3.20E+04	NA	E	3.21E+04
Phenylacetylene	536-74-3	NA		NA		NA	NA	NA	NA		
d-Limonene	5989-27-5	NA		NA		NA	NA	3.50E+05	NA	T	3.50E+05
Methylnitrite	624-91-9	NA		NA		NA	NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
Compound	CAS #	Region 9 PRG (µg/m³)	Toxicity Endpoint (Cancer/Non)	Region 3 RBC (µg/m³)	Toxicity Endpoint (Cancer/Non)	Health-based Screening Level (µg/m³)	ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (AEGL)	Acute Toxicity Value (µg/m³)
Acetonitrile	75-05-8	6.20E+01	nc	6.21E+01	nc	6.20E+01	NA	1.01E+05	NA	T	1.01E+05
Acrylonitrile	107-13-1	2.80E-02	c	2.61E-02	c	2.80E-02	2.20E+04	2.17E+04	NA	E	2.20E+04
Nitromethane	75-52-5	NA		NA		NA	NA	1.50E+05	NA	T	1.50E+05
Benzonitrile	100-47-0	NA		NA		NA	NA	1.50E+04	NA	T	1.50E+04
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04	NA	T	1.51E+04
4-Methylbenzonitrile	104-85-8	NA		NA		NA	NA	NA	NA		
Carbon Disulfide	75-15-0	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	3.73E+04	NA	T	3.73E+04
Thiophene	110-02-1	NA		NA		NA	NA	NA	NA		
Dimethyldisulfide	624-92-0	NA		NA		NA	4.00E+01	3.85E+01	NA	E	4.00E+01
2-Methylthiophene	554-14-3	NA		NA		NA	NA	NA	NA		
3-Methylthiophene	616-44-4	NA		NA		NA	NA	NA	NA		
Dimethyltrisulfide	3658-80-8	NA		NA		NA	NA	NA	NA		
1-Chlorobutane	109-69-3	1.46E+03	nc	1.46E+03	nc	1.46E+03	NA	NA	NA		
1-Bromo-2-chloroethane	107-04-0	NA		NA		NA	NA	NA	NA		
2-Bromo-1-chloropropane	3017-95-6	NA		NA		NA	NA	NA	NA		
1,2-Dichlorobutane	541-33-3	NA		NA		NA	NA	NA	NA		
1,2,3-Trichloropropane	96-18-4	9.61E-04	c	3.13E-03	c	9.61E-04	NA	1.81E+05	NA	T	1.81E+05
1-Chloro-2-methylbenzene	95-49-8	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	3.88E+05	NA	T	3.88E+05
1-Chloro-3-methylbenzene	108-41-8	NA		NA		NA	NA	NA	NA		
1-Chloro-4-ethylbenzene	622-98-0	NA		NA		NA	NA	NA	NA		
Pentachloro-1-propene	1600-37-9	NA		NA		NA	NA	NA	NA		
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01	NA	2.90E+04	NA	T	2.90E+04
1,2-Dichloro-3-methylbenzene	32768-54-0	NA		NA		NA	NA	NA	NA		
Carbonyl Sulfide	463-58-1	NA		NA		NA	NA	9.84E+03	NA	T	9.84E+03
Trichloroacetonitrile	545-06-2	NA		NA		NA	NA	NA	NA		
Dichloroacetonitrile	3018-12-0	NA		NA		NA	NA	NA	NA		
Isothiocyanatomethane	556-61-6	NA		NA		NA	NA	NA	NA		
1,1-Dichloro-2-propanone	513-88-2	NA		NA		NA	NA	NA	NA		
2-Thiophenecarboxaldehyde	98-03-3	NA		NA		NA	NA	NA	NA		
Acetaldehyde	75-07-0	8.73E-01	c	8.13E-01	c	8.73E-01	1.80E+04	1.80E+04	NA	E	1.80E+04
Ethanol	64-17-5	NA		NA		NA		5.64E+06	NA	T	5.64E+06
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc	2.09E-02	2.30E+02	2.29E+02	NA	E	2.30E+02
Acetone	67-64-1	3.40E+02	nc	3.65E+02	nc	3.40E+02	NA	2.37E+06	NA	T	2.37E+06
Propanal	123-38-6	NA		NA		NA	NA	7.50E+04	NA	T	7.50E+04
Furan	110-00-9	3.70E+00	nc	NA		3.70E+00	NA	1.67E+02	NA	T	1.67E+02
2-Propanol	67-63-0	NA		NA		NA	NA	9.84E+05	NA	T	9.84E+05
Methacrolein	78-85-3	NA		NA		NA	NA	NA	NA		
MTBE	1634-04-4	3.10E+03	nc	3.13E+03	nc	3.10E+03	NA	4.32E+05	NA	T	4.32E+05

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
		Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 5 REC (µg/m³)	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m³)	ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (AEGL or TEEL)	Acute Toxicity Value (µg/m³)
Methyl-vinyl ketone	78-94-4	NA		NA		NA	NA	8.61E+01	NA	T	8.61E+01
2,3-Butanedione	625-34-3	NA		NA		NA	NA	NA	NA		
Butanal	123-72-8	NA		NA		NA	NA	7.38E+04	NA	T	7.38E+04
2-Butanone	78-93-3	1.00E+03	nc	1.04E+03	nc	1.00E+03	NA	8.85E+05	NA	T	8.85E+05
2-Methylfuran	534-22-5	NA		NA		NA	NA	NA	NA		
3-Methylfuran	930-27-8	NA		NA		NA	NA	NA	NA		
trans-2-Butenal	123-73-9	3.54E-03	c	3.30E-03	c	3.54E-03	NA	NA	NA		
Tetrahydrofuran	109-99-9	9.89E-01	c	9.21E-01	c	9.89E-01		7.38E+05	NA	T	7.38E+05
3-Methyl-2-butanone	108-10-1	8.30E+01	nc	7.30E+01	nc	8.30E+01	NA	3.07E+05	NA	T	3.07E+05
Acetic Acid	64-19-7	NA		NA		NA	NA	3.68E+04	NA	T	3.68E+04
1-Butanol	71-36-3	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.52E+05	NA	T	1.52E+05
1-Penten-3-one	1629-58-9	NA		NA		NA		NA	NA		
2-Pentanone	107-87-9	NA		NA		NA	NA	8.80E+05	NA	T	8.80E+05
Pentanal	110-62-3	NA		NA		NA	NA	NA	NA		
2,3-Pentanedione	600-14-6	NA		NA		NA	NA	NA	NA		
1,2-Dichloro-2-methylpropane	594-37-6	NA		NA		NA	NA	NA	NA		
3-Pentanone	96-22-0	NA		NA		NA	NA	NA	NA		
2,5-Dimethylfuran	625-86-5	NA		NA		NA	NA	NA	NA		
4-Methyl-2-pentanone	108-10-1	8.30E+01	nc	7.30E+01	nc	8.30E+01	NA	3.07E+05	NA	T	3.07E+05
trans-3-Penten-2-one	3102-33-8	NA		NA		NA	NA	NA	NA		
Cyclopentanone	120-92-3	NA		NA		NA	NA	NA	NA		
2-Hexanone	591-78-6	NA		5.11E+00	nc	5.11E+00	NA	4.09E+04	NA	T	4.09E+04
Hexanal	66-25-1	NA		NA		NA	NA	NA	NA		
3-Furaldehyde	498-60-2	NA		NA		NA	NA	NA	NA		
2-Cyclopenten-1-one	930-30-3	NA		NA		NA	NA	NA	NA		
2-Furaldehyde	98-01-1	5.20E+01	nc	3.65E+01	nc	5.20E+01	NA	7.86E+03	NA	T	7.86E+03
1-Acetoxyacetone	592-20-1	NA		NA		NA	NA	NA	NA		
2-Heptanone	110-43-0	NA		NA		NA	NA	7.01E+05	NA	T	7.01E+05
Heptanal	66-25-1	NA		NA		NA	NA	NA	NA		
5-Methyl-2-furaldehyde	620-02-0	NA		NA		NA	NA	NA	NA		
Benzaldehyde	100-52-7	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04	NA	T	1.50E+04
Benzofuran	271-89-6	NA		NA		NA	NA	NA	NA		
Octanal	124-13-0	NA		NA		NA	NA	NA	NA		
Acetophenone	98-86-2	2.10E-02	nc	2.08E-02	nc	2.10E-02	NA	3.00E+04	NA	T	3.00E+04
2-Nonanone	821-55-6	NA		NA		NA	NA	NA	NA		
Nonanal	124-19-6	NA		NA		NA	NA	NA	NA		
N-Nitrosodimethylamine	62-75-9	1.40E-04	c	1.23E-04	c	1.40E-04	NA	2.50E+03	NA	T	2.50E+03
Pyridine	110-86-1	3.65E+00	nc	3.65E+00	nc	3.65E+00	NA	4.85E+04	NA	T	4.85E+04

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
Compound	CAS #	Region 9 PRG (µg/m3)	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m3)	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m3)	ERPG (µg/m3)	TEEL (µg/m3)	AEGL (µg/m3)	Source (A, E or T)	Acute Toxicity Value (µg/m3)
2-Picoline	109-06-8	NA		NA		NA	NA	NA	NA		
Methyl methanesulfonate	66-27-3	NA		NA		NA	NA	NA	NA		
N-Nitrosomethylethylamine	10595-95-6	3.06E-04	c	2.85E-04	c	3.06E-04	NA	NA	NA		
N-Nitrosodiethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05	NA	NA	NA		
Ethyl methanesulfonate	62-50-0	NA		NA		NA	NA	NA	NA		
Phenol	108-95-2	2.19E+03	nc	2.19E+03	nc	2.19E+03	3.85E+05	3.85E+04	NA	E	3.85E+05
Aniline	62-53-3	NA		1.06E+00	nc	1.06E+00	NA	2.29E+04	3.00E+04	A	3.00E+04
bis(2-Chloroethyl)ether	111-44-4	5.80E-03	c	5.69E-03	c	5.80E-03	NA	5.85E+04	NA	T	5.85E+04
Pentachloroethane	76-01-7	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
2-Chlorophenol	95-57-8	1.83E+01	nc	1.83E+01	nc	1.83E+01	NA	5.25E+03	NA	T	5.25E+03
1,3-Dichlorobenzene	543-73-1	NA		NA		NA	NA	NA	NA		
1,4-Dichlorobenzene	106-46-7	2.80E-01	c	2.85E-01	c	2.80E-01	NA	6.61E+05	NA	T	6.61E+05
Benzyl alcohol	100-51-6	1.10E+03	nc	1.10E+03	nc	1.10E+03	NA	5.53E+04	NA	T	5.53E+04
2-Methylphenol	95-48-7	1.83E+02	nc	1.83E+02	nc	1.83E+02	NA	6.63E+04	NA	T	6.63E+04
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05	NA	T	3.01E+05
bis(2-Chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c	1.92E-01	NA	6.99E+04	NA	T	6.99E+04
o-Toluidine	95-53-4	2.80E-02	c	2.61E-02	c	2.80E-02	NA	2.63E+04	NA	T	2.63E+04
4-Methylphenol/3-Methylphenol	1319-77-3	1.83E+01	nc	1.83E+01	nc	1.83E+01	NA	6.63E+04	NA	T	6.63E+04
N-Nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c	9.61E-04	NA	2.00E+02	NA	T	2.00E+02
Acetophenone	98-86-2	2.10E-02	nc	2.08E-02	nc	2.10E-02	NA	3.00E+04	NA	T	3.00E+04
N-Nitrosomorpholine	59-89-2	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
N-Nitrosopyrrolidine	930-55-2	3.15E-03	c	2.98E-03	c	3.15E-03	NA	NA	NA		
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01	NA	2.90E+04	NA	T	2.90E+04
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04	NA	T	1.51E+04
N-Nitrosopiperidine	100-75-4	NA		NA		NA	NA	NA	NA		
Isophorone	78-59-1	7.08E+00	c	6.59E+00	c	7.08E+00	NA	2.83E+04	NA	T	2.83E+04
2,4-Dimethylphenol	105-67-9	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	NA	NA		
2-Nitrophenol	88-75-5	NA		NA		NA	NA	NA	NA		
bis(2-Chloroethoxy)methane	111-91-1	NA		NA		NA	NA	NA	NA		
Benzoic acid	65-85-0	1.50E+04	nc	1.46E+04	nc	1.50E+04	NA	1.25E+04	NA	T	1.25E+04
2,4-Dichlorophenol	120-83-2	1.10E+01	nc	1.10E+01	nc	1.10E+01	NA	3.00E+04	NA	T	3.00E+04
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02	NA	3.71E+04	NA	T	3.71E+04
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	NA	7.86E+04	NA	T	7.86E+04
p-Chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	3.00E+04	NA	T	3.00E+04
2,6-Dichlorophenol	87-65-0	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
Hexachloropropene	1888-71-7	NA		NA		NA	NA	NA	NA		
Hexachlorobutadiene	87-68-3	8.62E-02	c	8.03E-02	c	8.62E-02	3.21E+04	3.20E+04	NA	E	3.21E+04
Dimethylphenethylamine	122-09-8	3.65E+00	nc	NA		3.65E+00	NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
		Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 3 RBC (µg/m³)	Toxicity Endpoint (c or nc)	Health-based Screening Level (µg/m³)	ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (AEGL or TEEL)	Acute Toxicity Value (µg/m³)
N-Nitroso-di-n-butylamine	924-16-3	1.20E-03	c	1.12E-03	c	1.20E-03	NA	NA	NA		
4-Chloro-3-methylphenol	35421-08-0	NA		NA		NA	NA	NA	NA		
Safrole	94-59-7	NA		NA		NA	NA	NA	NA		
2-Methylnaphthalene	91-57-6	NA		NA		NA	NA	2.00E+04	NA	T	2.00E+04
1,2,4,5-Tetrachlorobenzene	95-94-3	1.10E+00	nc	1.10E+00	nc	1.10E+00	NA	3.00E+04	NA	T	3.00E+04
Hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc	7.30E-02	NA	2.23E+02	NA	T	2.23E+02
2,4,6-Trichlorophenol	88-06-2	6.20E-01	c	6.26E-01	c	6.20E-01	NA	3.00E+04	NA	T	3.00E+04
2,4,5-Trichlorophenol	95-95-4	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	3.00E+04	NA	T	3.00E+04
Isosafrole	120-58-1	NA		NA		NA	NA	NA	NA		
2-Chloronaphthalene	91-58-7	2.92E+02	nc	2.92E+02	nc	2.92E+02	NA	6.00E+02	NA	T	6.00E+02
2-Nitroaniline	88-74-4	2.09E-01	nc	2.08E-01	nc	2.09E-01	NA	NA	NA		
1,4-Naphthoquinone	130-15-4	NA		NA		NA	NA	2.50E+02	NA	T	2.50E+02
Dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc	3.65E+04	NA	1.50E+04	NA	T	1.50E+04
1,3-Dinitrobenzene	99-65-0	3.65E-01	nc	3.65E-01	nc	3.65E-01	NA	3.00E+03	NA	T	3.00E+03
2,6-Dinitrotoluene	606-20-2	3.65E+00	nc	3.65E+00	nc	3.65E+00	NA	6.00E+02	NA	T	6.00E+02
Acenaphthylene	208-96-8	NA		NA		NA	NA	2.00E+02	NA	T	2.00E+02
3-Nitroaniline	99-09-2	NA		NA		NA	NA	NA	NA		
4-Nitrophenol	100-02-7	2.90E+01	nc	2.92E+01	nc	2.90E+01	NA	3.00E+04	NA	T	3.00E+04
2,4-Dinitrophenol	51-28-5	7.30E+00	nc	7.30E+00	nc	7.30E+00	NA	7.50E+03	NA	T	7.50E+03
Acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc	2.19E+02	NA	1.25E+03	NA	T	1.25E+03
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc	7.30E+00	NA	6.00E+02	NA	T	6.00E+02
Dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	1.50E+00	NA	T	1.50E+00
Pentachlorobenzene	608-93-5	2.92E+00	nc	2.92E+00	nc	2.92E+00	NA	3.00E+04	NA	T	3.00E+04
1-Naphthylamine	134-32-7	NA		NA		NA	NA	3.50E+04	NA	T	3.50E+04
2-Naphthylamine	91-59-8	NA		NA		NA	NA	7.50E+03	NA	T	7.50E+03
2,3,4,6-Tetrachlorophenol	58-90-2	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	NA	NA		
Diethylphthalate	84-66-2	2.92E+03	nc	2.92E+03	nc	2.92E+03	NA	1.50E+04	NA	T	1.50E+04
4-Chlorophenylphenyl ether	7005-72-3	NA		NA		NA	NA	NA	NA		
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	7.50E+04	NA	T	7.50E+04
5-Nitro-o-toluidine	99-55-8	2.00E-01	c	1.90E-01	c	2.00E-01	NA	NA	NA		
4-Nitroaniline	100-01-6	NA		NA		NA	NA	9.00E+03	NA	T	9.00E+03
4,6-Dinitro-2-methylphenol	534-52-1	NA		3.65E-01	nc	3.65E-01	NA	5.00E+02	NA	T	5.00E+02
Diphenylamine/N-NitrosoDPA	62-75-9	1.37E-04	c	1.23E-04	c	1.37E-04	NA	2.50E+03	NA	T	2.50E+03
sym-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	3.00E+04	NA	T	3.00E+04
Diallate	2303-16-4	1.10E-01	c	NA		1.10E-01	NA	NA	NA		
Phenacetin	62-44-2	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
4-Bromophenylphenyl ether	101-55-3	NA		NA		NA	NA	NA	NA		
Hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c	4.18E-03	NA	7.50E+01	NA	T	7.50E+01

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)				
Compound	CAS #	Region 9 PRG (µg/m³)	Toxicity Endpoint (Code)	Region 3 RBC (µg/m³)	Toxicity Endpoint (Code)	Health-based Screening Level (µg/m³)	ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (AEGL or TEEL)	Acute Toxicity Value (µg/m³)
4-Aminobiphenyl	92-67-1	NA		NA		NA	NA	1.50E+03	NA	T	1.50E+03
Pronamide	23950-58-5	2.74E+02	nc	NA		2.74E+02	NA	NA	NA		
Pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c	5.60E-02	NA	1.50E+03	NA	T	1.50E+03
Pentachloronitrobenzene	82-68-8	2.59E-02	c	2.41E-02	c	2.59E-02	NA	1.50E+03	NA	T	1.50E+03
Phenanthrene	85-01-8	NA		NA		NA	NA	2.00E+03	NA	T	2.00E+03
Anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc	1.10E+03	NA	6.00E+03	NA	T	6.00E+03
Carbazole	86-74-8	3.36E-01	c	3.13E-01	c	3.36E-01	NA	NA	NA		
Di-n-butylphthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04	NA	T	1.50E+04
4-Nitroquinoline-1-oxide	56-57-5	NA		NA		NA	NA	NA	NA		
Methapyrilene	91-80-5	NA		NA		NA	NA	NA	NA		
Fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	3.00E+01	NA	T	3.00E+01
Benzidine	92-87-5	2.90E-05	c	2.90E+00	c	2.90E-05	NA	5.00E+02	NA	T	5.00E+02
Pyrene	129-00-0	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	1.50E+04	NA	T	1.50E+04
p-Dimethylaminoazobenzene	60-11-7	NA		NA		NA	NA	7.50E+04	NA	T	7.50E+04
Chlorobenzilate	510-15-6	2.49E-02	c	2.32E-02	c	2.49E-02	NA	2.50E+02	NA	T	2.50E+02
Kepone	143-50-0	3.74E-04	c	NA		3.74E-04	NA	1.00E+02	NA	T	1.00E+02
Butylbenzylphthalate	85-68-7	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	5.00E+05	NA	T	5.00E+05
3,3'-Dimethylbenzidine	119-93-7	7.30E-04	c	6.81E-04	c	7.30E-04	NA	3.00E+00	NA	T	3.00E+00
2-Acetylaminofluorene	53-96-3	NA		NA		NA	NA	2.50E+03	NA	T	2.50E+03
bis(2-Ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01	NA	1.00E+04	NA	T	1.00E+04
3,3'-Dichlorobenzidine	91-94-1	1.50E-02	c	1.39E-02	c	1.50E-02	NA	6.21E+03	NA	T	6.21E+03
Benz(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c	2.17E-02	NA	6.00E+02	NA	T	6.00E+02
Chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00	NA	2.00E+02	NA	T	2.00E+02
Di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	1.50E+05	NA	T	1.50E+05
7,12-Dimethylbenz(a)anthracene	57-97-6	NA		NA		NA	NA	NA	NA		
Benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA	NA		
Benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c	2.17E-01	NA	NA	NA		
Benz(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c	2.17E-03	NA	7.50E+03	NA	T	7.50E+03
3-Methylcholanthrene	56-49-5	NA		NA		NA	NA	1.50E+03	NA	T	1.50E+03
Indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA	NA		
Dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03	NA	3.00E+04	NA	T	3.00E+04
Benzo(g,h,i)perylene	191-24-2	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
2-(2-quinolinyl)-(H)-indene-1,3-(2H)-dione		NA		NA		NA	NA	NA	NA		
Benzanthrone	82-05-3	NA		NA		NA	NA	NA	NA		
Tetrachloroethene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00	NA	6.78E+05	NA	T	6.78E+05
(1,2-dichloroethyl)-benzene	1074-11-9	NA		NA		NA	NA	NA	NA		
4-phenoxy-2(1H)-quinolinone	66662-28-0	NA		NA		NA	NA	NA	NA		
3-(phenylhydrazone)-1H-Indole-2,3-dione		NA		NA		NA	NA	NA	NA		

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	For the Chronic Evaluation (HBSL): Region 9 PRG (µg/m³)	Toxicity Endpoint (c or nc)	Region 9 Ref. Conc. (µg/m³)	Toxicity Endpoint (c or nc)	Health-based screening level (µg/m³)	For the Acute Evaluation (ATV): ERPG (µg/m³)	TEEL (µg/m³)	AEGL (µg/m³)	Source (A, E, or T)	Acute Toxicity Value (µg/m³)
4-1,2,4-oxadizaolin-3-one-2,5-diphenyl-delta		NA		NA		NA	NA	NA	NA		
2-amino-9,10-anthracenedione	117-79-3	NA		NA		NA	NA	NA	NA		

Footnotes:
PRG: Preliminary Remediation Goals
c: Cancer
nc:non-cancer
RBC: Risk-Based Concentration
HBSL: Health-based Screening Level
(E) ERPG: Emergency Response Planning Guidelines
(T) TEEL: Temporary Emergency Exposure Limits
ATV: Acute Toxicity Value
NA: Not available

APPENDIX D

RISK EVALUATION DATA

Table D-1: Comparison of Air Concentrations With Health-Based Values: Metals, Particulates and Miscellaneous Compounds

	Red Smoke Grenade							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
TSP	5.72E-01	5.00E+01	1.14E-02	no	1.00E+03	NV		na
HCl (a)	1.04E-05	2.08E+01	4.99E-07	no	7.28E-02	4.47E+03	1.63E-05	no
Cl_2 (a)	6.06E-07	2.09E-01	2.91E-06	no	1.06E-03	2.90E+03	3.66E-07	no
Dioxin TEQ (b)	3.78E-11	4.48E-08	8.42E-04	no	6.17E-07	3.50E+00	1.76E-07	no
Carbon Monoxide	2.19E-02	1.57E+02	1.39E-04	no	3.84E+01	2.30E+05	1.67E-04	no
Nitrogen Oxide	1.60E-03	1.00E+02	1.60E-05	no	1.12E+01	2.70E+05	4.15E-05	no
HCl (a)	2.57E-04	2.08E+01	1.23E-05	no	1.80E+00	4.47E+03	4.04E-04	no
Carbon Dioxide	2.92E-01	NV		na	2.04E+03	5.40E+07	3.79E-05	no
Sulfur Dioxide	1.65E-03	8.00E+01	2.06E-05	no	2.89E+00	7.89E+02	3.65E-03	no
Aluminum	1.96E-04	3.65E+00	5.38E-05	no	1.38E+00	3.00E+04	4.59E-05	no
Antimony	2.83E-06	1.46E+00	1.94E-06	no	1.98E-02	1.50E+03	1.32E-05	no
Arsenic	NA	4.47E-04		na	NA	3.00E+01		na
Barium	1.95E-06	5.21E-01	3.75E-06	no	1.37E-02	1.50E+03	9.13E-06	no
Beryllium	2.63E-13	8.00E-04	3.29E-10	no	4.30E-03	5.00E+00	8.60E-04	no
Cadmium	NA	1.07E-03		na	NA	3.00E+01		na
Chromium	6.76E-07	1.53E-04	4.43E-03	no	1.11E-02	1.50E+03	7.37E-06	no
Cobalt	5.15E-07	2.20E+02	2.34E-09	no	3.61E-03	6.00E+01	6.01E-05	no
Copper	NA	1.46E+02		na	NA	3.00E+03		na
Lead	7.60E-05	1.50E+00	5.07E-05	no	5.33E-01	1.50E+02	3.55E-03	no
Magnesium	4.49E-05	NV		na	3.15E-01	3.00E+04	1.05E-05	no
Manganese	1.61E-06	5.11E-02	3.14E-05	no	1.13E-02	3.00E+03	3.75E-06	no
Nickel	1.69E-06	7.30E+01	2.31E-08	no	1.18E-02	3.00E+03	3.94E-06	no
Phosphorus	NA	NV		na	NA	3.00E+02		na
Selenium	NA	1.83E+01		na	NA	6.00E+02		na
Silver	NA	1.83E+01		na	NA	3.00E+02		na
Thallium	NA	2.56E-01		na	NA	3.00E+02		na
Zinc	3.60E-05	1.10E+03	3.28E-08	no	2.52E-01	3.00E+04	8.40E-06	no
Mercury	7.57E-13	3.13E-01	2.42E-12	no	5.30E-03	1.00E+02	5.30E-05	no

Footnote:

(a) HCl/Cl_2 levels were too low to be reliably measured.

(b) Presence questionable - reported at similar levels in samples and blanks.

NA = Not applicable because compound was not detected.

na = Not available because health-based screening value is not available or not applicable if compound was not detected.

NV = No value

$C_{chronic}$ = Chronic time-averaged concentration ; HBSL = Chronic health-based screening level

C_{acute} = Acute concentration; ATV = Acute toxicity value

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

Compound (a)	Red Smoke Grenade							
	$C_{chronic}$ (µg/m³)	Health-Based Screening Level (µg/m³)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m³)	Acute Toxicity Value (µg/m³)	C_{acute}/ ATV	> 1?
Total Nonmethane Hydrocarbons (TNMHC)								
TNMHC	1.92E-03	NV		na	3.36E+00	NV		na
Volatile Organic Compounds (VOCs)								
Ethane	5.45E-06	NV		na	9.55E-03	NV		na
Ethylene	2.21E-04	NV		na	1.55E+00	4.60E+05	3.36E-06	no
Acetylene	3.35E-04	NV		na	5.87E-01	NV		na
Propane	1.41E-06	NV		na	9.89E-03	3.78E+06	2.62E-09	no
Propene	5.68E-05	NV		na	9.95E-02	NV		na
i-Butane	1.37E-07	NV		na	9.60E-04	5.71E+06	1.68E-10	no
i-Butene	7.61E-06	NV		na	1.33E-02	NV		na
1-Butene	1.18E-05	NV		na	2.06E-02	NV		na
1,3-Butadiene	1.24E-07	3.74E-03	3.32E-05	no	5.07E-04	2.20E+04	2.31E-08	no
n-Butane	5.40E-07	NV		na	3.79E-03	5.71E+06	6.63E-10	no
trans-2-Butene	1.07E-05	NV		na	1.88E-02	NV		na
2,2-Dimethylpropane	NA	NV		na	NA	NV		na
cis-2-Butene	2.49E-06	NV		na	4.37E-03	NV		na
3-Methyl-1-butene	1.92E-06	NV		na	3.36E-03	NV		na
i-Pentane	NA	NV		na	NA	1.80E+06		na
1-Pentene	5.70E-06	NV		na	9.99E-03	NV		na
2-Methyl-1-butene	3.26E-06	NV		na	5.71E-03	NV		na
n-Pentane	NA	NV		na	NA	1.80E+06		na
Isoprene	NA	NV		na	NA	NV		na
trans-2-Pentene	3.26E-06	NV		na	5.71E-03	NV		na
cis-2-Pentene	NA	NV		na	NA	NV		na
2-Methyl-2-butene	NA	NV		na	NA	NV		na
2,2-Dimethylbutane	NA	NV		na	NA	1.80E+06		na
Cyclopentene	NA	NV		na	NA	NV		na
4-Methyl-1-pentene	NA	NV		na	NA	NV		na
Cyclopentane	NA	NV		na	NA	NV		na
2,3-Dimethylbutane	NA	NV		na	NA	NV		na
cis-4-Methyl-2-pentene	NA	NV		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
2-Methylpentane	NA	NV		na	NA	1.80E+06		na
3-Methylpentane	NA	NV		na	NA	NV		na
2-Methyl-1-pentene	NA	NV		na	NA	NV		na
1-Hexene	7.06E-06	NV		na	4.95E-02	1.03E+05	4.80E-07	no
n-Hexane	NA	2.10E+02		na	NA	5.28E+05		na
trans-2-Hexene	NA	NV		na	NA	NV		na
2-Methyl-2-pentene	NA	NV		na	NA	NV		na
cis-2-Hexene	NA	NV		na	NA	NV		na
Methylcyclopentane	NA	NV		na	NA	NV		na
2,4-Dimethylpentane	NA	NV		na	NA	NV		na
Benzene	2.65E-05	2.50E-01	1.06E-04	no	1.09E-01	1.56E+05	6.96E-07	no
Cyclohexane	NA	NV		na	NA	3.10E+06		na
2-Methylhexane	NA	NV		na	NA	NV		na
2,3-Dimethylpentane	NA	NV		na	NA	NV		na
3-Methylhexane	NA	NV		na	NA	NV		na
2,2,4-Trimethylpentane	NA	NV		na	NA	3.50E+05		na
n-Heptane	NA	NV		na	NA	1.80E+06		na
2,4,4-Trimethyl-1-pentene	NA	NV		na	NA	NV		na
Methylcyclohexane	NA	3.10E+03		na	NA	4.81E+06		na
2,4,4-Trimethyl-2-pentene	NA	NV		na	NA	NV		na
2,5-Dimethylhexane	NA	NV		na	NA	NV		na
2,4-Dimethylhexane	NA	NV		na	NA	NV		na
2,3,4-Trimethylpentane	NA	NV		na	NA	NV		na
Toluene	6.50E-06	4.02E+02	1.62E-08	no	1.14E-02	1.88E+05	6.07E-08	no
2,3-Dimethylhexane	NA	NV		na	NA	NV		na
2-Methylheptane	NA	NV		na	NA	NV		na
3-Ethylhexane	NA	NV		na	NA	NV		na
2,2-Dimethylheptane	NA	NV		na	NA	NV		na
2,2,4-Trimethylhexane	NA	NV		na	NA	NV		na
n-Octane	NA	NV		na	NA	NV		na
Ethylcyclohexane	NA	NV		na	NA	NV		na
Ethylbenzene	2.36E-06	1.10E+03	2.14E-09	no	1.65E-02	5.43E+05	3.04E-08	no

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
m-Xylene & p-Xylene	1.50E-05	NV		na	1.05E-01	6.51E+05	1.61E-07	no
Styrene	NA	1.10E+03		na	NA	2.13E+05		na
o-Xylene	1.38E-06	7.30E+02	1.88E-09	no	9.64E-03	6.51E+05	1.48E-08	no
n-Nonane	NA	4.02E+02		na	NA	1.05E+06		na
i-Propylbenzene	NA	4.00E+02		na	NA	7.37E+05		na
n-Propylbenzene	NA	3.65E+01		na	NA	3.68E+05		na
p-Ethyltoluene	NA	NV		na	NA	1.25E+05		na
m-Ethyltoluene	NA	NV		na	NA	NV		na
1,3,5-Trimethylbenzene	NA	6.20E+00		na	NA	3.68E+05		na
o-Ethyltoluene	NA	NV		na	NA	7.50E+02		na
1,2,4-Trimethylbenzene & sec-Butylbenzene	NA	6.21E+00		na	NA	1.80E+05		na
n-Decane	3.97E-06	NV		na	2.79E-02	4.37E+03	6.38E-06	no
alpha-Pinene	NA	NV		na	NA	4.00E+04		na
beta-Pinene	NA	NV		na	NA	NV		na
delta 3-Carene	NA	NV		na	NA	NV		na
d-Limonene	NA	NV		na	NA	3.50E+05		na
MTBE	NA	3.10E+03		na	NA	4.32E+05		na
Dichlorodifluoromethane	6.01E-07	2.10E+02	2.86E-09	no	4.21E-03	1.48E+07	2.84E-10	no
Methylchloride	NA	1.07E+00		na	NA	NV		na
Dichlorotetrafluoroethane	NA	NV		na	NA	NV		na
Chloroethene	3.33E-06	2.20E-02	1.51E-04	no	5.44E-02	1.28E+04	4.27E-06	no
1,3-Butadiene	1.26E-07	3.74E-03	3.38E-05	no	5.16E-04	2.20E+04	2.35E-08	no
Methylbromide	NA	5.20E+00		na	NA	5.82E+04		na
Ethylchloride	2.45E-07	2.30E+00	1.06E-07	no	4.01E-03	7.92E+06	5.06E-10	no
Trichloromonofluoromethane	NA	7.30E+02		na	NA	2.81E+06		na
Vinylidenechloride	6.50E-07	5.26E+08	1.24E-15	no	1.06E-02	7.92E+04	1.34E-07	no
Methylenechloride	3.88E-06	4.10E+00	9.47E-07	no	1.59E-02	6.96E+05	2.28E-08	no
Allylchloride	NA	1.04E+00		na	NA	9.39E+03		na
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	3.13E+04		na	NA	9.58E+06		na
1,1-Dichloroethane	NA	5.21E+02		na	NA	1.21E+06		na
1,2-Dichloroethene	1.83E-06	3.29E+01	5.58E-08	no	3.21E-03	5.30E+04	6.06E-08	no

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Chloroform	2.16E-05	8.35E-02	2.59E-04	no	3.53E-01	9.76E+03	3.62E-05	no
1,2-Dichloroethane	NA	7.39E-02		na	NA	8.08E+03		na
Methylchloroform	NA	1.04E+03		na	NA	1.94E+06		na
Benzene	2.70E-05	2.49E-01	1.08E-04	no	4.41E-01	1.60E+05	2.77E-06	no
Carbontetrachloride	2.00E-06	1.28E-01	1.56E-05	no	3.51E-03	1.28E+05	2.74E-08	no
1,2-Dichloropropane	NA	9.89E-02		na	NA	5.08E+05		na
Trichloroethylene	7.15E-07	1.12E+00	6.38E-07	no	1.17E-02	5.37E+05	2.18E-08	no
cis 1,3-Dichloro-1-propene	NA	NV		na	NA	1.14E+04		na
trans 1,3-Dichloro-1-propene	NA	NV		na	NA	NV		na
1,1,2-Trichloroethane	NA	1.20E-01		na	NA	1.64E+05		na
Toluene	6.61E-06	4.02E+02	1.65E-08	no	1.16E-02	1.88E+05	6.18E-08	no
1,2-Dibromoethane	NA	8.73E-03		na	NA	1.54E+05		na
Perchloroethylene	1.03E-06	3.31E+00	3.11E-07	no	4.22E-03	6.89E+05	6.12E-09	no
Chlorobenzene	4.79E-06	6.20E+01	7.73E-08	no	3.36E-02	1.38E+05	2.43E-07	no
Ethylbenzene	3.62E-06	1.06E+03	3.42E-09	no	2.53E-02	5.43E+05	4.67E-08	no
m&p-Xylene	1.52E-05	7.30E+02	2.09E-08	no	1.07E-01	6.51E+05	1.64E-07	no
Styrene	NA	1.06E+03		na	NA	2.13E+05		na
1,1,2,2-Tetrachloroethane	NA	3.31E-02		na	NA	2.06E+04		na
o-Xylene	1.40E-06	7.30E+02	1.92E-09	no	9.81E-03	6.51E+05	1.51E-08	no
p-Ethyltoluene	NA	NV		na	NA	1.25E+05		na
1,3,5-Trimethylbenzene	NA	6.21E+00		na	NA	3.68E+05		na
1,2,4-Trimethylbenzene	NA	6.21E+00		na	NA	1.80E+05		na
Benzylchloride	NA	3.96E-02		na	NA	5.20E+03		na
m-Dichlorobenzene	4.27E-07	3.29E+00	1.30E-07	no	2.99E-03	3.61E+04	8.29E-08	no
p-Dichlorobenzene	1.32E-07	3.06E-01	4.32E-07	no	2.16E-03	6.61E+05	3.27E-09	no
o-Dichlorobenzene	4.39E-06	2.09E+02	2.10E-08	no	3.07E-02	3.01E+05	1.02E-07	no
1,2,4-Trichlorobenzene	1.97E-07	2.08E+02	9.47E-10	no	1.38E-03	3.71E+04	3.72E-08	no
Hexachlorobutadiene	2.04E-06	8.73E-02	2.34E-05	no	8.35E-03	3.21E+04	2.60E-07	no
Phenylacetylene	3.99E-06	NV		na	7.00E-03	NV		na
d-Limonene	NA	NV		na	NA	3.50E+05		na
Methylnitrite	5.55E-06	NV		na	9.72E-03	NV		na
Acetonitrile	1.12E-05	6.20E+01	1.80E-07	no	7.82E-02	1.01E+05	7.76E-07	no

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Acrylonitrile	1.58E-06	2.80E-02	5.65E-05	no	6.46E-03	2.20E+04	2.94E-07	no
Nitromethane	3.33E-06	NV		na	2.33E-02	1.50E+05	1.55E-07	no
Benzonitrile	1.47E-05	NV		na	1.03E-01	1.50E+04	6.86E-06	no
Nitrobenzene	5.08E-06	2.09E+00	2.43E-06	no	3.56E-02	1.51E+04	2.36E-06	no
4-Methylbenzonitrile	NA	NV		na	NA	NV		na
Carbon Disulfide	1.37E-03	7.30E+02	1.88E-06	no	9.61E+00	3.73E+04	2.58E-04	no
Thiophene	8.94E-05	NV		na	1.57E-01	NV		na
Dimethyldisulfide	3.31E-05	NV		na	5.79E-02	4.00E+01	1.45E-03	no
2-Methylthiophene	4.40E-06	NV		na	7.71E-03	NV		na
3-Methylthiophene	3.74E-06	NV		na	6.54E-03	NV		na
Dimethyltrisulfide	4.87E-05	NV		na	8.54E-02	NV		na
1-Chlorobutane	NA	1.46E+03		na	NA	NV		na
1-Bromo-2-chloroethane	NA	NV		na	NA	NV		na
2-Bromo-1-chloropropane	NA	NV		na	NA	NV		na
1,2-Dichlorobutane	NA	NV		na	NA	NV		na
1,2,3-Trichloropropane	NA	9.61E-04		na	NA	1.81E+05		na
1-Chloro-2-methylbenzene	3.69E-04	7.30E+01	5.06E-06	no	2.59E+00	3.88E+05	6.67E-06	no
1-Chloro-3-methylbenzene	3.04E-05	NV		na	5.32E-02	NV		na
1-Chloro-4-ethylbenzene	NA	NV		na	NA	NV		na
Pentachloro-1-propene	NA	NV		na	NA	NV		na
Hexachloroethane	1.08E-06	4.80E-01	2.25E-06	no	1.77E-02	2.90E+04	6.09E-07	no
1,2-Dichloro-3-methylbenzene	NA	NV		na	NA	NV		na
Carbonyl Sulfide	1.28E-05	NV		na	8.96E-02	9.84E+03	9.11E-06	no
Trichloroacetonitrile	NA	NV		na	NA	NV		na
Dichloroacetonitrile	4.44E-06	NV		na	7.78E-03	NV		na
Isothiocyanatomethane	2.39E-05	NV		na	4.20E-02	NV		na
1,1-Dichloro-2-propanone	NA	NV		na	NA	NV		na
2-Thiophenecarboxaldehyde	4.24E-06	NV		na	7.42E-03	NV		na
Acetaldehyde	7.42E-05	8.73E-01	8.50E-05	no	3.03E-01	1.80E+04	1.68E-05	no
Ethanol	3.46E-06	NV		na	2.43E-02	5.64E+06	4.30E-09	no
Acrolein	9.88E-05	2.09E-02	4.74E-03	no	1.73E-01	2.30E+02	7.53E-04	no
Acetone	3.34E-04	3.40E+02	9.82E-07	no	2.34E+00	2.37E+06	9.87E-07	no

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Propanal	NA	NV		na	NA	7.50E+04		na
Furan	2.47E-05	3.70E+00	6.67E-06	no	1.73E-01	1.67E+02	1.04E-03	no
2-Propanol	7.13E-07	NV		na	4.99E-03	9.84E+05	5.07E-09	no
Methacrolein	8.16E-06	NV		na	1.43E-02	NV		na
MTBE	NA	3.10E+03		na	NA	4.32E+05		na
Methyl-vinyl ketone	1.62E-05	NV		na	1.14E-01	8.61E+01	1.32E-03	no
2,3-Butanedione	3.00E-05	NV		na	5.26E-02	NV		na
Butanal	5.06E-06	NV		na	3.55E-02	7.38E+04	4.81E-07	no
2-Butanone	1.33E-05	1.00E+03	1.33E-08	no	9.30E-02	8.85E+05	1.05E-07	no
2-Methylfuran	1.43E-06	NV		na	2.50E-03	NV		na
3-Methylfuran	NA	NV		na	NA	NV		na
trans-2-Butenal	1.14E-05	3.54E-03	3.22E-03	no	4.66E-02	NV		na
Tetrahydrofuran	NA	9.89E-01		na	NA	7.38E+05		na
3-Methyl-2-butanone	NA	8.30E+01		na	NA	3.07E+05		na
Acetic Acid	2.96E-06	NV		na	2.08E-02	3.68E+04	5.65E-07	no
1-Butanol	3.12E-06	3.65E+02	8.55E-09	no	2.19E-02	1.52E+05	1.44E-07	no
1-Penten-3-one	NA	NV		na	NA	NV		na
2-Pentanone	1.77E-06	NV		na	1.24E-02	8.80E+05	1.41E-08	no
Pentanal	NA	NV		na	NA	NV		na
2.3-Pentanedione	NA	NV		na	NA	NV		na
1,2-Dichloro-2-methylpropane	NA	NV		na	NA	NV		na
3-Pentanone	NA	NV		na	NA	NV		na
2.5-Dimethylfuran	NA	NV		na	NA	NV		na
4-Methyl-2-pentanone	3.70E-06	8.30E+01	4.46E-08	no	2.59E-02	3.07E+05	8.45E-08	no
trans-3-Penten-2-one	NA	NV		na	NA	NV		na
Cyclopentanone	NA	NV		na	NA	NV		na
2-Hexanone	NA	5.11E+00		na	NA	4.09E+04		na
Hexanal	5.70E-06	NV		na	9.98E-03	NV		na
3-Furaldehyde	2.21E-05	NV		na	3.87E-02	NV		na
2-Cyclopenten-1-one	NA	NV		na	NA	NV		na
2-Furaldehyde	5.82E-05	5.20E+01	1.12E-06	no	4.08E-01	7.86E+03	5.19E-05	no
1-Acetoxyacetone	NA	NV		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	Red Smoke Grenade							
Compound (a)	**$C_{chronic}$ (µg/m³)**	**Health-Based Screening Level (µg/m³)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} (µg/m³)**	**Acute Toxicity Value (µg/m³)**	**C_{acute}/ ATV**	**> 1?**
2-Heptanone	7.34E-07	NV		na	5.14E-03	7.01E+05	7.34E-09	no
Heptanal	1.43E-06	NV		na	2.51E-03	NV		na
5-Methyl-2-furaldehyde	NA	NV		na	NA	NV		na
Benzaldehyde	2.20E-05	3.65E+02	6.03E-08	no	1.54E-01	1.50E+04	1.03E-05	no
Benzofuran	6.49E-06	NV		na	1.14E-02	NV		na
Octanal	2.02E-06	NV		na	3.55E-03	NV		na
Acetophenone	NA	NV		na	NA	3.00E+04		na
2-Nonanone	NA	NV		na	NA	NV		na
Nonanal	1.81E-06	NV		na	3.17E-03	NV		na

Footnotes:
(a) Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.
NA = Not applicable
na = Not available because health-based screening value is not available or not applicable because compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration
HBSL = Chronic health-based screening level
C_{acute} = Acute concentration
ATV = Acute toxicity value

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

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Compound	Red Smoke Grenade							
	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Particulate/Vapor-phase SVOCs								
N-Nitrosodimethylamine	NA	1.40E-04		na	NA	2.50E+03		na
Pyridine	NA	3.65E+00		na	NA	4.85E+04		na
2-Picoline	NA	NV		na	NA	NV		na
Methyl methanesulfonate	NA	NV		na	NA	NV		na
N-Nitrosomethylethylamine	NA	3.06E-04		na	NA	NV		na
N-Nitrosodiethylamine	NA	4.47E-05		na	NA	NV		na
Ethyl methanesulfonate	NA	NV		na	NA	NV		na
Phenol	NA	2.19E+03		na	NA	3.85E+05		na
Aniline	NA	1.06E+00		na	NA	3.00E+04		na
bis(2-Chloroethyl)ether	NA	5.80E-03		na	NA	5.85E+04		na
Pentachloroethane	NA	NV		na	NA	3.00E+04		na
2-Chlorophenol	NA	1.83E+01		na	NA	5.25E+03		na
1,3-Dichlorobenzene	NA	NV		na	NA	NV		na
1,4-Dichlorobenzene	NA	2.80E-01		na	NA	6.61E+05		na
Benzyl alcohol	NA	1.10E+03		na	NA	5.53E+04		na
2-Methylphenol	NA	1.83E+02		na	NA	6.63E+04		na
1,2-Dichlorobenzene	NA	2.09E+02		na	NA	3.01E+05		na
bis(2-Chloroisopropyl)ether	NA	1.92E-01		na	NA	6.99E+04		na
o-Toluidine	NA	2.80E-02		na	NA	2.63E+04		na
4-Methylphenol/3-Methylphenol	NA	1.83E+01		na	NA	6.63E+04		na
N-Nitroso-di-n-propylamine	NA	9.61E-04		na	NA	2.00E+02		na
Acetophenone	NA	2.10E-02		na	NA	3.00E+04		na
N-Nitrosomorpholine	NA	NV		na	NA	3.00E+04		na
N-Nitrosopyrrolidine	NA	3.15E-03		na	NA	NV		na
Hexachloroethane	NA	4.80E-01		na	NA	2.90E+04		na
Nitrobenzene	NA	2.09E+00		na	NA	1.51E+04		na
N-Nitrosopiperidine	NA	NV		na	NA	NV		na
Isophorone	NA	7.08E+00		na	NA	2.83E+04		na
2,4-Dimethylphenol	NA	7.30E+01		na	NA	NV		na
2-Nitrophenol	NA	NV		na	NA	NV		na
bis(2-Chloroethoxy)methane	NA	NV		na	NA	NV		na
Benzoic acid	NA	1.50E+04		na	NA	1.25E+04		na
2,4-Dichlorophenol	NA	1.10E+01		na	NA	3.00E+04		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

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Compound	Red Smoke Grenade							
	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
1,2,4-Trichlorobenzene	NA	2.08E+02		na	NA	3.71E+04		na
Naphthalene	NA	3.13E+00		na	NA	7.86E+04		na
p-Chloroaniline	NA	1.46E+01		na	NA	3.00E+04		na
2,6-Dichlorophenol	NA	NV		na	NA	3.00E+04		na
Hexachloropropene	NA	NV		na	NA	NV		na
Hexachlorobutadiene	NA	8.62E-02		na	NA	3.21E+04		na
Dimethylphenethylamine	NA	3.65E+00		na	NA	NV		na
N-Nitroso-di-n-butylamine	NA	1.20E-03		na	NA	NV		na
4-Chloro-3-methylphenol	NA	NV		na	NA	NV		na
Safrole	NA	NV		na	NA	NV		na
2-Methylnaphthalene	NA	NV		na	NA	2.00E+04		na
1,2,4,5-Tetrachlorobenzene	NA	1.10E+00		na	NA	3.00E+04		na
Hexachlorocyclopentadiene	NA	7.30E-02		na	NA	2.23E+02		na
2,4,6-Trichlorophenol	NA	6.20E-01		na	NA	3.00E+04		na
2,4,5-Trichlorophenol	NA	3.65E+02		na	NA	3.00E+04		na
Isosafrole	NA	NV		na	NA	NV		na
2-Chloronaphthalene	NA	2.92E+02		na	NA	6.00E+02		na
2-Nitroaniline	NA	2.09E-01		na	NA	NV		na
1,4-Naphthoquinone	NA	NV		na	NA	2.50E+02		na
Dimethylphthalate	NA	3.65E+04		na	NA	1.50E+04		na
1,3-Dinitrobenzene	NA	3.65E-01		na	NA	3.00E+03		na
2,6-Dinitrotoluene	NA	3.65E+00		na	NA	6.00E+02		na
Acenaphthylene	NA	NV		na	NA	2.00E+02		na
3-Nitroaniline	NA	NV		na	NA	NV		na
4-Nitrophenol	NA	2.90E+01		na	NA	3.00E+04		na
2,4-Dinitrophenol	NA	7.30E+00		na	NA	7.50E+03		na
Acenaphthene	NA	2.19E+02		na	NA	1.25E+03		na
2,4-Dinitrotoluene	NA	7.30E+00		na	NA	6.00E+02		na
Dibenzofuran	NA	1.46E+01		na	NA	1.50E+00		na
Pentachlorobenzene	NA	2.92E+00		na	NA	3.00E+04		na
1-Naphthylamine	NA	NV		na	NA	3.50E+04		na
2-Naphthylamine	NA	NV		na	NA	7.50E+03		na
2,3,4,6-Tetrachlorophenol	NA	1.10E+02		na	NA	NV		na
Diethylphthalate	NA	2.92E+03		na	NA	1.50E+04		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

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	Red Smoke Grenade							
Compound	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
4-Chlorophenylphenyl ether	NA	NV		na	NA	NV		na
Fluorene	NA	1.46E+02		na	NA	7.50E+04		na
5-Nitro-o-toluidine	NA	2.00E-01		na	NA	NV		na
4-Nitroaniline	NA	NV		na	NA	9.00E+03		na
4,6-Dinitro-2-methylphenol	NA	3.65E-01		na	NA	5.00E+02		na
Diphenylamine/N-NitrosoDPA	NA	1.37E-04		na	NA	2.50E+03		na
sym-Trinitrobenzene	NA	1.10E+02		na	NA	3.00E+04		na
Diallate	NA	1.10E-01		na	NA	NV		na
Phenacetin	NA	NV		na	NA	3.00E+04		na
4-Bromophenylphenyl ether	NA	NV		na	NA	NV		na
Hexachlorobenzene	NA	4.18E-03		na	NA	7.50E+01		na
4-Aminobiphenyl	NA	NV		na	NA	1.50E+03		na
Pronamide	NA	2.74E+02		na	NA	NV		na
Pentachlorophenol	NA	5.60E-02		na	NA	1.50E+03		na
Pentachloronitrobenzene	NA	2.59E-02		na	NA	1.50E+03		na
Phenanthrene	NA	NV		na	NA	2.00E+03		na
Anthracene	NA	1.10E+03		na	NA	6.00E+03		na
Carbazole	NA	3.36E-01		na	NA	NV		na
Di-n-butylphthalate	NA	3.65E+02		na	NA	1.50E+04		na
4-Nitroquinoline-1-oxide	NA	NV		na	NA	NV		na
Methapyrilene	NA	NV		na	NA	NV		na
Fluoranthene	NA	1.46E+02		na	NA	3.00E+01		na
Benzidine	NA	2.90E-05		na	NA	5.00E+02		na
Pyrene	NA	1.10E+02		na	NA	1.50E+04		na
p-Dimethylaminoazobenzene	NA	NV		na	NA	7.50E+04		na
Chlorobenzilate	NA	2.49E-02		na	NA	2.50E+02		na
Kepone	NA	3.74E-04		na	NA	1.00E+02		na
Butylbenzylphthalate	NA	7.30E+02		na	NA	5.00E+05		na
3,3'-Dimethylbenzidine	NA	7.30E-04		na	NA	3.00E+00		na
2-Acetylaminofluorene	NA	NV		na	NA	2.50E+03		na
bis(2-Ethylhexyl)phthalate	NA	4.80E-01		na	NA	1.00E+04		na
3,3'-Dichlorobenzidine	NA	1.50E-02		na	NA	6.21E+03		na
Benz(a)anthracene	NA	2.17E-02		na	NA	6.00E+02		na
Chrysene	NA	2.17E+00		na	NA	2.00E+02		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

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Compound	Red Smoke Grenade							
	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Di-n-octylphthalate	NA	7.30E+01		na	NA	1.50E+05		na
7,12-Dimethylbenz(a)anthracene	NA	NV		na	NA	NV		na
Benzo(b)fluoranthene	NA	2.17E-02		na	NA	NV		na
Benzo(k)fluoranthene	NA	2.17E-01		na	NA	NV		na
Benz(a)pyrene	NA	2.17E-03		na	NA	7.50E+03		na
3-Methylcholanthrene	NA	NV		na	NA	1.50E+03		na
Indeno(1,2,3-cd)pyrene	NA	2.17E-02		na	NA	NV		na
Dibenz(a,h)anthracene	NA	2.17E-03		na	NA	3.00E+04		na
Benzo(g,h,i)perylene	NA	NV		na	NA	3.00E+04		na
2-(2-quinolinyl)-(H-indene-1,3-(2H)-dione	NA	NV		na	NA	NV		na
Benzanthrone	NA	NV		na	NA	NV		na
Tetrachloroethene	NA	3.31E+00		na	NA	6.78E+05		na
(1,2-dichloroethyl)-benzene	NA	NV		na	NA	NV		na
4-phenoxy-2(1H)-quinolinone	NA	NV		na	NA	NV		na
3-(phenylhydrazone)-1H-Indole-2,3-dione	2.34E-01	NV		na	4.10E+02	NV		na
4-1,2,4-oxadizaolin-3-one-2,5-diphenyl-delta	NA	NV		na	NA	NV		na
2-amino-9,10-anthracenedione	9.61E-03	NV		na	1.68E+01	NV		na

Footnotes:
NA = Not applicable
na = Not available because health-based screening value is not available or not applicable because compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration
HBSL = Chronic health-based screening level
C_{acute} = Acute concentration
ATV = Acute toxicity value

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	Red Smoke Grenade			
Compound (a)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	*Aliphatic:C>8*	*Aromatic:C<=8*	*Aromatic:C>8*
$C_{chronic}$/HBSL	5.87E-09	0.00E+00	1.76E-07	1.16E-07
>1?	no	no	no	no

Footnotes:
(a) Items in bold represent duplicate values: highest concentration was used to estimate total petroleum hydrocarbon concentration
>1? = Is the ratio greater than one?
NA = Not Applicable because compound was not detected
$C_{chronic}$ = chronic averaged air Concentration
HBSL = Health-Based Screening Level

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

Compound (a)	Red Smoke Grenade			
	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	*Aliphatic:C>8*	*Aromatic:C<=8*	*Aromatic:C>8*
Propane	1.41E-06	NA	NA	NA
Propene	5.68E-05	NA	NA	NA
i-Butane	1.37E-07	NA	NA	NA
i-Butene	7.61E-06	NA	NA	NA
1-Butene	1.18E-05	NA	NA	NA
n-Butane	5.40E-07	NA	NA	NA
trans-2-Butene	1.07E-05	NA	NA	NA
cis-2-Butene	2.49E-06	NA	NA	NA
3-Methyl-1-butene	1.92E-06	NA	NA	NA
1-Pentene	5.70E-06	NA	NA	NA
2-Methyl-1-butene	3.26E-06	NA	NA	NA
trans-2-Pentene	3.26E-06	NA	NA	NA
1-Hexene	7.06E-06	NA	NA	NA
Benzene	NA	NA	6.19E-05	NA
Toluene	NA	NA	6.50E-06	NA
Ethylbenzene	NA	NA	2.36E-06	NA
m-Xylene & p-Xylene	NA	NA	1.50E-05	NA
o-Xylene	NA	NA	1.38E-06	NA
n-Decane	NA	NA	NA	3.97E-06
Benzene	NA	NA	6.30E-05	NA
Toluene	NA	NA	6.61E-06	NA
Ethylbenzene	NA	NA	3.62E-06	NA
m&p-Xylene	NA	NA	1.52E-05	NA
o-Xylene	NA	NA	1.40E-06	NA
Phenylacetylene	NA	NA	3.99E-06	NA
Total (µg/m^3)	1.13E-04	0.00E+00	7.36E-05	2.42E-05
Derived Health-Based Screening Level	1.92E+04	1.04E+03	4.17E+02	2.09E+02

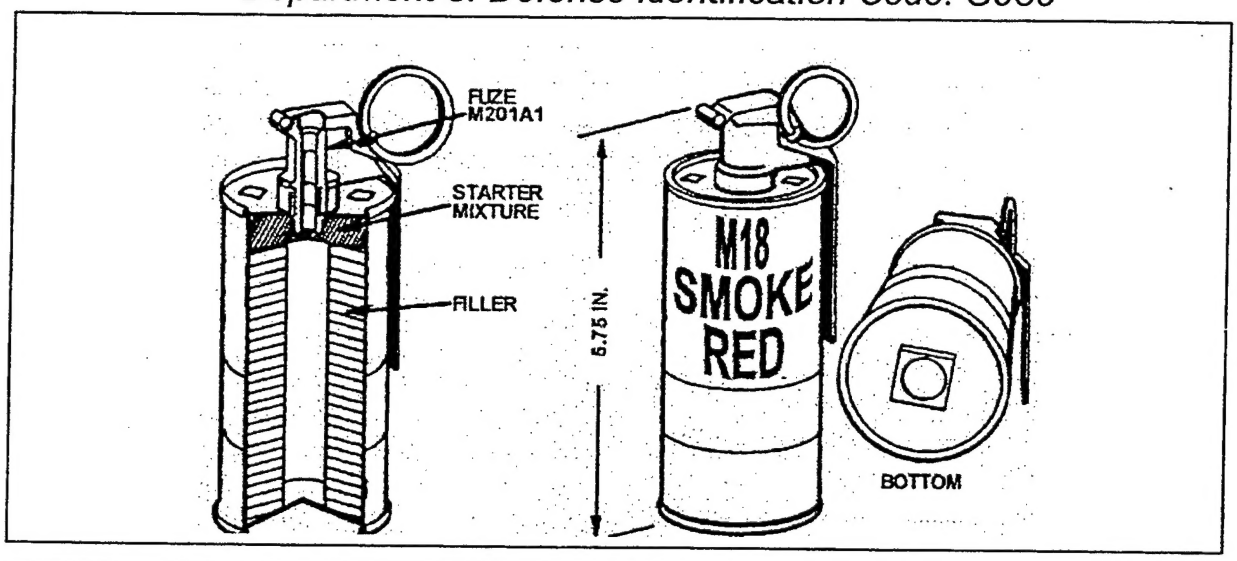
APPENDIX E

FACT SHEET SUBMITTED TO AEC

United States Army Environmental Center
Pyrotechnics Fact Sheet

M18 Red-Colored Smoke Grenade

Department of Defense Identification Code: G950



Breathing air emissions from the red-colored smoke grenade will not impact the health of residents who live near Army training facilities.

WHAT ARE PYROTECHNICS?

The terms pyrotechnics and fireworks are often used interchangeably. Pyrotechnics are devices that give off smoke, light, and/or a loud noise when activated. In the military, pyrotechnics are used for signaling, obscuring, and illuminating during training and combat.

WHAT IS THE M18?

The M18 smoke grenade is a type of pyrotechnic device used by troops for ground-to-ground or ground-to-air signaling. The M18 may be filled with one of four different smoke colors. These different colored smoke signals can be seen over great distances when used against a terrain background of contrasting colors. The M18 is 5.75 inches long, 2.50 inches in diameter, and weighs 19 ounces.

HOW IS THE M18 USED?

The M18 contains a delay-igniting fuze so that smoke is not released immediately after the grenade is activated. This allows the user to throw the grenade, usually to a distance of about 35 meters (115 feet) before smoke is produced. The M18 will emit a cloud of colored smoke for 50 to 90 seconds. This colored smoke can be used for different purposes. For example, it can be used to mark friendly force locations for other ground troops. It can also be used to mark a landing zone during operations such as medical evacuation.

WHERE IS THE RED-COLORED M18 USED?

The red-colored M18 is used during many Army training events. These events are held at nearly every Army training installation. At most locations, the training areas are at least 1000 meters (over half a mile) away from populated areas. In general, two of these items are used during a day of training, which typically occurs five times per year.

WHAT IS IN THE RED-COLORED M18?

The body of the red-colored M18 consists of a thin cylinder of sheet metal that is filled with a red smoke mixture. This mixture us made up mostly of a red dye, potassium chlorate, and sodium bicarbonate (same as baking soda).

WILL BREATHING AIR EMISSIONS FROM THE RED-COLORED M18 AFFECT MY HEALTH?

To answer this question, the U.S. Army Environmental Center tested the air emissions from the red-colored M18. The U.S. Army Center for Health Promotion and Preventive Medicine then determined if there would be a potential for health effects from inhalation to residents living near training areas. Results showed that residents breathing air as close as 100 meters (328 feet) from the activation site are safe from these emissions.

HOW WAS THE STUDY DONE?

To gather data for the study, airborne emissions were collected by activating the red-colored M18 in a test chamber. The air in the chamber was tested to identify the types and the amount of substances released. More than 300 substances were looked for during this part of the study.

This information was then used in an air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance, to which someone living near a training area might be exposed. Downwind concentrations were estimated based on a typical use scenario for the red-colored M18. Since the study does not look at a specific training area, the assumptions used in the model will in most cases, predict higher downwind air concentrations than those expected at an actual training site.

These estimated air concentrations were then compared to safe screening levels established by the U.S. Environmental Protection Agency and other agencies. If the air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children.

WHAT ARE THE LIMITATIONS OF THIS STUDY?

Many steps were taken to ensure that the results of this study are protective of everyone who lives close to training areas. However, limitations do exist with this study. For example, the study does not consider exposure to other types of munitions that could also be used during the same training event. Due to these limitations, conservative model conditions were used to ensure the protection of public health from inhalation of the red-colored M18 air emissions.

WHERE CAN I GET MORE INFORMATION?

For more information on the M18 and other military munitions call the Army Environmental Hotline at 1-800-USA-3845, visit our website at www.aec.army.mil, or email us at t2hotline@aec.apgea.army.mil.